African Perspectives on the Clean Development Mechanism

Papers presented at the Regional Workshop *New Partnerships for Sustainable Development: The Clean Development Mechanism under the Kyoto Protocol*, Accra, Ghana, 21-24 September 1998

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Executive Summary

This working paper is a compilation of papers presented to the workshop *New Partnerships for Sustainable Development: The Clean Development Mechanism under the Kyoto Protocol*, and held in Accra, Ghana, from September 21-24, 1998. The workshop, which was organised the UNEP Collaborating Centre on Energy and Environment, was sponsored by Ministry of Foreign Affairs, Denmark, UNEP and UNDP.

The papers, which are all written from an African perspective, are an important contribution to the debate surrounding the relevance and applicability of the Clean Development Mechanism in Africa. In addition to sector-specific discussions on the prospects for CDM in the energy, transport, industry and forestry sectors, various authors have attempted to tackle complex issues related to the institutional design of CDM, its mode of operation, participatory implementation and methodological questions such as baselines and additionality.

According to Ogunlade Davidson and Youba Sokona the political commitment to meet the problem of climate change exists in Africa despite the continent's low contribution to global greenhouse gas emissions. The sustainable development opportunities that the CDM may introduce are particularly important in Africa, and mitigation strategies offer opportunities for it to choose more environmentally friendly development options. Rather than be undertaken on an ad-hoc basis, CDM projects should be implemented within a national programme to ensure meaningful contribution to development objectives. Projects should be carefully selected for high development benefits, while contributing to sustainability and technology transfer. An examination of the AIJ pilot phase indicates that CDM opportunities will exist in Africa due to comparatively low marginal costs and that there is a high potential for technology transfer, capital flows and overall stimulation of the business environment. However, stronger national capacities are needed to realise these benefits. Aspects of an enabling environment for CDM include appropriate regulatory structures, institutional frameworks, adequate infrastructure, and the existence of project developers, business managers, capable local contractors and firm partnership links between the private sector, government and NGOs.

Some of the main conceptual issues relating to the CDM debate – baselines and additionality – are presented in the paper by Maya and Turkson. The paper recognises the immense importance of the determination of project-level emission reductions. Such a determination can only be made with reference to a pre-determined emission baseline(s). A general baseline perspective for Africa is given in this paper in order to give an indication of what may be possible economic and emission trends. While it is accepted that such a continent-wide baseline is of no practical use in deciding CDM activities, it remains imperative that Africa should have a common perspective on which to base its global negotiations. The paper presents the economic and emissions background for Africa, and notes that there needs to be a systematic analysis of any departure from baseline conditions to a CDM path. This also involves possible definitions of baselines and additionality. In the framework baseline for Africa, the authors make the best guess regarding economic development trends in various economies, make assumptions about the technology mix, assess the energy content and the carbon intensity of energy, then project emission trends. They suggest that use of a rolling baseline would be interesting from a methodological point of view. The paper also stresses that reduction in emissions from CDM projects must be additional to those that would have otherwise occurred. To assess CDM projects, the concept of a project baseline seems to be a logical choice. In many of the African mitigation studies, GDP growth rates have been one of the parameters used to

project GHG emissions. Maya and Turkson caution that one has to be careful in projections for countries that are experiencing low or declining economic growth. Any choice of an optimistic growth rate could overshoot the estimation of the GHG emissions from sectors and make CDM projects for GHG emissions reduction more attractive than they should be.

Participatory implementation and governance of the CDM is the topic of the paper by Timothy Afful-Koomson and Paul Opoku-Mensah. The limited scope of GEF and AIJ, their lack of flexibility and their inability to meet new patterns of finance demands, provide logistical support and ensure universality in participation and implementation have necessitated the establishment of the CDM. The CDM is now the main mechanism for resource transfer between developed and developing countries. Its ability to live up to its promise of meeting the objective of the UNFCCC while enabling sustainable development will depend upon the extent of involvement of major stakeholders. The paper defines the major stakeholders in CDM projects and seeks to provide a framework for participatory implementation and governance based on the CDM project cycle. Stakeholders include the local community, multilateral and regional development banks, NGOs and academic and research institutions. Local communities are important because CERs are not the ultimate objective of the project, and the local population should therefore have a central role in defining the project's objectives and ensuring its viability. Multilateral and regional development banks are involved in financing the non-CDM elements of projects and the decision-making processes of these institutions need to be directed towards sustainable development. NGOs have an important role to play in forging partnerships and making the most of their local knowledge, while academic and research institutions could provide assistance in the evaluation, certification, verification and monitoring stages of CDM, therefore reducing the administrative burden.

The CDM could be compromised in its early years if poorly planned and implemented. Therefore, Steve Lennon´s paper suggests a planning and pilot phase where the principles and modalities for CDM can be tested. He proposes several potential mechanisms for the operation of the CDM, including regional or national CDM Agencies to manage and facilitate projects. The functions of these agencies could include the establishment of partnerships between CDM participants, monitoring and verification, reporting to the CDM Executive Board, trading of Certified Emission Reductions, brokering and banking, and the identification and funding of adaptation projects. Their operation would be funded out of the proceeds of projects, but there should be initial seed funding, for instance from GEF. With regard to adaptation, the paper suggests that projects be funded from a centralised fund, as suggested in the Kyoto Protocol, and proceeds from CDM projects in the country concerned. It is essential that African countries develop strategic adaptation programmes, which may for example focus on areas such as water provision programmes, food security and flood management.

Francis Yamba presents criteria for assessing the sustainable development aspects of CDM projects. Sustainable development can be seen to consist of financial, economic, environmental, technological and social aspects. Financial sustainability can be assessed by standard indicators and is necessary to attract the private sector to a CDM project. Economic sustainability in the energy sector will involve projects that show a large degree of resilience and lower the burden created by energy sector investments. Environmental sustainability can be viewed at both global and local levels. One way of assessing technological sustainability would be to consider the share of energy output derived from energy conservation and renewable sources. Social sustainability indicators may include access to power supply, energy affordability, employment creation, poverty eradication, and gender equality benefits. Based on Zambia's greenhouse gas emission scenarios, Yamba presents three main areas where

CDM projects could lead to sustainable development in Zambia. These are forest management, household energy use, and use of sugar cane resources. The paper then provides a qualitative assessment of the comparative benefits of these three options from the perspective of sustainability.

The potential contribution of the CDM to the Energy Sector in Africa is reviewed in the paper by Randall Spalding-Fecher, Khorommbi Matibe and Gillian Simmonds. Africa produced 3% of global CO2 emissions in 1990, a figure that strongly indicates that participation in the flexible mechanisms of the Kyoto Protocol must be based on avoided future emissions. The starting point for CDM projects in the energy sector must be regional energy sector priorities. Approaches and strategies include structural energy sector reform to enhance performance, attract investment and widen access to commercial fuels, access to cleaner technologies, regional energy trade and interconnections, a wider range of technological choice, regional cooperation on standards, technological development and policy and the environmentally sound use of traditional fuels. Mitigation projects tend to address a narrower range of issues. For CDM to address the sustainability concerns its scope must be broader than conceived under AIJ or JI. In other words, CDM must be more than technology development and project-level implementation efforts. The strategic design of CDM must also include socio-economic and development indicators. One of the largest barriers to its implementation is that the institutional capacity and organisational and administrative structure required to develop and implement climate change policy is absent. Therefore, in considering the institutional design of the CDM, it is important to realise that a systematic and proactive approach may be needed to attract CDM investors to Africa.

J.Abeeku Brew-Hammond introduces a 12-point agenda for sustainable energy. These objectives may be applied to concrete projects and hence can be used in the determination of sustainability for the purpose of CDM projects. There is a brief discussion of Africa's low level of participation in the pilot phase of Activities Implemented Jointly (AIJ) and the need to learn lessons from the AIJ experience is underscored. It is argued that if the CDM is to do better than the AIJ in Africa then a marriage between sustainable energy objectives and avoided future emissions will be indispensable. The paper highlights potential projects for CDM financing, ranging from regional power-sharing networks and gas pipelines to energy efficiency and decentralised rural energy services that put more emphasis on productive activities. It also points to the general lack of information concerning the newly emerging opportunities from climate-related financing mechanisms like AIJ and CDM as one of the problems requiring urgent attention and a major effort at information dissemination among the key stakeholders.

The issues related to CDM project design in the transport sector are addressed in the paper by Peter Zhou. The transport sector is the engine for economic growth in Africa and also one of its fastest growing sectors in terms of energy and infrastructure demand. To reduce transport energy demand and associated GHG emissions, Africa needs to improve transport energy efficiency through the provision of adequate infrastructure and substitute petroleum products with energy efficient and low emission fuels and energy sources. Funding from GEF and AIJ has not been available to projects in the transport sector in Africa but there are potential mitigation options that would be suitable for implementation under the CDM. These include fuel substitution with local sources and natural gas-based fuels, replacing old cars and LDVs, improving mass transit systems and developing road and rail infrastructure networks. However, a key problem is that baseline calculation is difficult for transport projects due to a dependence on travel forecasting and the scarcity of data. In addition, the lack of uniform emissions

factors for the various transport modes and their operating conditions is a problem that needs to be addressed. The most straightforward CDM projects to choose in the short-term would therefore be projects that can be translated into bulk replacement of known petroleum demand by low GHG emission fuels or energy sources, or corridor transport studies where monitoring of traffic is possible and modal shares can be estimated. It will, however, be difficult to frame certain urban planning and transport management projects under CDM as such options cannot be directly correlated with GHG emission reductions.

In the final paper, Timothy Afful-Koomson discusses the cost-effectiveness and potential benefits of forestry mitigation projects under the CDM. According to the study presented in the paper, CDM forestry projects could generate substantial financial benefits to rural communities in Ghana without the need for changing the scale or pattern of rural production activities. It is, however, important that the CDM should consider the conformity of projects with national forestry priorities, national development objectives, patterns of rural resource utilisation and equitable distribution of project costs and benefits. To secure Ghana's economic security, CDM must provide the investment for generating higher development options from forests while managing them sustainably. There is a high probability of failure of forestry projects in Africa due to the shortage of financial resources, lack of managerial capacity and technical constraints and the absence of adequate monitoring and evaluation of project costs and benefits. Effective community participation can help to ensure the viability of projects, but may involve agreements for equitable allocation of responsibilities, rights and benefits to the forestry products and sequestration proceeds. The direct benefits of forestry projects may include fuelwood, construction poles and timber. Indirect benefits include employment opportunities, control of air pollution and micro-climate, watershed protection and the development of social infrastructure. The additionality provision of Article 12 could potentially restrict CDM forestry projects to those that are not already due for implementation under national forestry plans. However, if additional projects are also taken to mean those that involve improving forestry practices or monitoring arrangements the scope for CDM projects in the forestry sector will be increased.

In summary, it is hoped that these papers, presented by expert African authors, will enhance the understanding of the potential for and challenges to the operation of the Clean Development Mechanism in Africa. A full understanding of African regional constraints and opportunities will be essential if CDM is to achieve the complex and demanding task set for it by the world community.

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Africa and the Clean Development Mechanism:Perspectives for Growth

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Introduction

African countries have contributed less than 7% of the world's greenhouse gas (GHG) emissions. In spite of this, nearly all African countries are actively involved in solving the pending problem of climate change. At the UNCED held in Rio de Janeiro, Brazil in 1992, 38 out of the 53 African countries present signed the UNFCCC, and 12 had ratified it by March 1994, before it came to force. Presently, this number has grown to 44, a clear indication of Africa's political commitment to achieving the objectives of the UNFCCC. In December 1997, at the third Conference of the Parties to the Convention (COP3), over 160 countries adopted a Protocol to the UNFCCC, the " Kyoto Protocol'. In article 12 of this Protocol, three 'flexible mechanisms' were proposed. One of these, the "Clean Development Mechanism (CDM)" has its origin in a proposal by the Brazilian Government, which called for the establishment of a Clean Development Fund, to be based on taxes from countries who defaulted on their commitments to the Protocol. Since the adoption of the Protocol, there has been considerable interest by both developed and developing countries because the CDM is seen by many as a means of promoting sustainable development while reducing GHG emissions. However, there are major issues that will need to be resolved in subsequent conferences and seminars.

According to Article 12.2 of the Protocol, the two main objectives of the CDM are to help non-Annex 1 countries achieve sustainable development and to realise the ultimate objective of the UNFCCC by assisting Annex 1 Parties to achieve compliance with their quantified emission limitation and reduction commitments. Achieving sustainable development, one of the key criteria of the CDM, is of particular importance to all non-Annex 1 Parties. This is so because of the legitimate demands in non-Annex 1 parties for improvement in the standard of living of their citizens. Many African countries need to reduce poverty significantly while managing their fragile environment. Hence, meeting their present developmental goals without compromising the ability of future generations to meet their own needs is of great concern to African countries.

CDM compliments Article 3, which relates to commitments from Annex 1 Parties to the Convention by allowing certified emission reductions from projects in non-Annex 1 Parties to be used in meeting the commitments of Annex 1 Parties. However, credits from joint projects in non-Annex 1 Parties will have to be certified by operational entities to be designated by the Conference of Parties before the certified reduction credits can be used by the Annex 1 Parties to comply with Article 3 of the Protocol.

Provided the necessary modalities of operation are worked out, CDM could offer significant opportunities for non-Annex 1 Parties, including the transfer of financial flows and climate-friendly technologies from Annex 1 Parties through certified projects. This paper intends to contribute towards the development of these modalities by introducing the key issues relating to CDM and its relationship with another implementing mechanism of the Protocol, AIJ, and with other financial mechanisms. The enabling environment for accessing the opportunities that may emerge from CDM is also discussed.

Climate Change and Development

As previously mentioned, Africa's share of global GHG emissions is very small, only 7.6% of the most important greenhouse gas, carbon dioxide (WRI, 1996). However, there has been a steady increase of carbon emissions from the continent, rising from 25 to 184 million metric tons of carbon between 1950 and 1991. During the same period, per capita emissions rose from 0.12 to 0.28 metric tons of carbon. Solid fuels continue to dominate the emissions, claiming about 41% in 1991, down from 73% in 1950. Liquid fuels, accounted for 38% in 1991, compared to only 28% in 1950, a direct result of the increased use of oil-based fuels (ORNL, 1994). Emissions from gas and cement production are very small, although increasing use of gas will change this situation in the future. With the exception of South Africa, which depends significantly on coal for power production and presently accounts for about 1.4% of global GHG emissions, the emissions from Africa will continue to be low in global terms for the immediate future.

Despite the low contribution by African countries to atmospheric GHG emissions because of their low consumption of fossil fuels and level of industrialisation, the continent has been described as the most vulnerable to the impacts of climate change (IPCC, 1998). The relatively low capacities in African countries and their high dependence on natural systems for the livelihood of their citizens will weaken the ability of these countries to respond to the adverse impacts of climate change. A recent IPCC report indicates that the temperature of the continent may rise by about 0.2 °C per decade up to the year 2050, with the coastal zones warming more slowly than the interior, and that this warming may lead to increased open water and soil/plant evaporation. Also, an average rise in sea level of around 25 cm is expected by the year 2050. These changes may have profound effects on terrestrial ecosystems, hydrology and water resources, and agriculture and food security in Africa. Depending on the economic performance of countries, the impact on their socio-economic systems could be devastating. African countries need to develop adaptive strategies to cope with these expected impacts.

However, African countries should be fully involved in mitigation strategies as well as adaptation strategies because mitigation strategies offer them opportunities to choose more environmentally-friendly options to improve the overall quality of life of their citizens. Pre-

sently, Africa is the lowest consumer of high quality energy, one of the main driving forces for effective socio-economic growth in any nation. Development options for growth in the energy sector can significantly assist African countries to make major steps in supplying improved energy for use in demand sectors such as the household, transport and industry. Two areas of the energy sector where substantial improvements could benefit African countries significantly are energy efficiency and renewable energy sources. Also, improvements in the agricultural sector could greatly improve food security in the continent and reduce food imports. The impact of this move on the overall economy would be substantial.

The challenge therefore is for African countries to develop useful and effective adaptation and mitigation strategies to cope with their development demands while satisfying the objectives of the UNFCCC. Despite the current civil strife and political instability in some areas of the continent, the economic recovery that started a few years ago has been sustained for the last five years with economic growth continuing to surpass population growth. In 1997, economic growth was about 3%. Although this is less than the figure of 4.4% for the previous year, the population increased by only 2.6%, and the growth rate has been forecast at around 4% for 1998. During 1997, 38 of the African countries monitored by the United Nations showed positive growth, and almost 40% of the group with growth rates of over 5%. Over 70% of these had growth rates of at least 6-7% (UN, 1998). High oil prices and improved agricultural output were singled out as the main factors driving these promising growth figures. This trend gives room for cautious optimism about the economic future of the continent because both external economic factors and internal conflicts could have weakened this growth.

The Clean Development Mechanism: Key Issues of Concern

As mentioned earlier, the Clean Development Mechanism (CDM) is one of the three implementing mechanisms set out in the Kyoto Protocol to satisfy the objectives of the UNFCCC. These mechanisms are Joint Implementation (JI)1, CDM2, and Emissions Trading3. Emissions Trading and JI are limited at present to Annex 1 parties and so fall outside the scope of this paper. Article 12 has not fully defined the structure and operation of the CDM. Its objectives are to help promote sustainable development in non-Annex 1 Parties and to assist Annex 1 Parties in achieving compliance with their emissions reduction targets. These objectives are to be met through the execution of climate change projects in non-Annex I countries. The Kyoto Protocol calls for the establishment of an Executive Board to act as a facilitator for the certification of emissions reductions. The main components of the CDM are:

- CDM projects should be compatible with the development objectives and environmental needs of the country in which the project is implemented.
- Certified emissions reductions from CDM projects in non-Annex 1 parties which are real and measurable can be counted towards the emission reduction targets of the investing Annex 1 parties.

1 Article 6

2 Article 12

3 Article 17

- Reductions from CDM should be additional to those from uncertified projects.
- A share of the proceeds from certified projects shall be used to assist particularly vulnerable non-Annex 1 Parties in meeting the costs of adaptation to the adverse impacts of climate change.
- Certified emission reductions during the period 2000-2008 can be banked and used in the first commitment period (2008-2012).
- Projects can involve private or public entities.
- A share of the proceeds from certified projects will be used to cover administrative expenses.

However, there are many issues that remain unresolved and require detailed discussion and broad agreement before the CDM becomes operational and effective. These issues include the following:

- Evaluation of emissions baselines. This will prove complicated and thus there will be an opportunity for cheating by countries. Hence stringent criteria will be needed in order to ensure that the credits claimed are those accrued after the start of CDM.
- Evaluation of costs to reflect full marginal costs and to test the hypothesis of cheaper marginal costs for non-Annex 1 Parties.
- Modalities and procedures for CDM
- The composition of the Executive Board of the CDM. It must be free from undue influences from existing bilateral agreements and institutions.

In addition to these issues, African countries need to pay particular attention to the following because of their specific needs and their overall poor competitive situation in the world economy:

- Many countries have not realised the full benefits of development projects because they were implemented in an ad-hoc manner. Hence CDM projects should be undertaken within a national programme approach to ensure meaningful contribution to overall development objectives.
- Due attention should given to the selection of CDM projects because if low cost options are chosen at an early stage, African countries will find it more difficult to undertake high cost/ high development benefit options later.
- The fragility of Africa's environment and its economic situation should be reflected in the choice of CDM projects, ensuring that the chosen development paths are sustainable.
- CDM projects should involve significant and genuine technology transfer flows so that technological capability is greatly enhanced.
- Inclusion of sinks projects in the CDM will require careful analysis.

In general, however, all CDM projects should be based on the same principles as the Convention: cost-effectiveness, intra and intergenerational equity, common but differentiated responsibilities, and special needs of developing countries (food production and sustainable development). These principles- especially the latter- are of utmost importance for the full involvement of developing countries, because their urgent developmental needs cannot be ignored.

CDM and Activities Implimented Jointly (AIJ)

Joint Implementation (JI) refers to bilateral agreements by Parties on activities that are aimed at satisfying the objective of the Convention. At COP1, held in Berlin in June 1995, Parties agreed to set up a trial period (1995-2000) for this mechanism under the name 'Activities to be implemented jointly (AIJ)'. In Article 6 of the Kyoto Protocol, Annex 1 Parties are given permission to use JI as a means of meeting their commitments. Projects that have additional reductions of GHG emissions compared to an assigned baseline can give Annex 1 Parties credits that can be used to meet their commitments. Since 1995, several AIJ projects have emerged between Annex 1 Parties and also between Annex 1 and non-Annex 1 Parties. Of the 103 AIJ projects that were endorsed by the national authorities in the host and investing countries, only 2 were in Africa4. These were the Uganda National Park FACE project in Uganda and the Sustainable Energy Management project in Burkina Faso. Since that time, two more projects have been approved by USIJI for South Africa and Tanzania. Hence, Participation by African countries in the AIJ pilot programme has been minimal.

There are some similarities between AIJ and CDM. These similarities can be summarised as follows:

- Both mechanisms are market-based for the transfer of financial and technological resources.
- Both emerged from the concept of GHG offset transfer or trading.
- Both rely on major disparities in abatement costs among Parties.

Despite these similarities, there are also major differences that require comment. These include:

- CDM will have credits while no credits have been granted in the AIJ pilot phase.
- CDM has a sustainable development focus while AIJ has a climate change focus.

The operation of the AIJ projects at the global level can provide some lessons for the development of future CDM projects. Among these are:

- Significant CDM opportunities exist in non-Annex 1 countries because of their comparatively low marginal costs.
- The potential exists for technology transfer as technology packages.

Despite these positive comments, there have been some negative experiences during AIJ, such as:

- Limited private sector involvement because of the lack of credits
- Limited participation by regions such as Africa, mainly due to ignorance or scepticism about the mechanism.
- Skewed geographic distribution of projects, with participation limited to traditional recipients of foreign direct assistance.
- The need for stronger national capacities to benefit from such mechanisms.

4 As of February 1998

CDM and other Financial Assistance Programs

Existing financial assistance programs will be affected by CDM because past experience shows that it is difficult to set up new and additional finances from the same source. Hence, funding for CDM can be influenced by existing relationships. Programmes likely to be affected are the existing sources of finance for funding the incremental cost of climate projects in developing countries, the Global Environment Facility (GEF), and Foreign Direct Investment (FDI).

As was stated in the Protocol, CDM should be additional to existing financial programs. GEF funds can be a very good catalyst for CDM funding and so can be complimentary. Also, CDM funds can be used for setting up initial programs, which could be replicated using FDI funds.

Likely Benefits and Problems of CDM

Provided suitable policies and measures are taken to establish an effective system for the operation of CDM, this mechanism can prove beneficial to many developing countries, especially African countries that have a relatively greater need for development projects. These benefits include:

- CDM can attract an increased flow of investments and capital intensive projects.
- CDM can act as a major stimulant for technology co-operation and partnership
- CDM can stimulate market development and expand existing markets
- CDM will improve the overall business environment
- CDM can reduce the overall abatement cost by investing in countries with lower marginal costs
- CDM can greatly enhance the negotiating capacity of Parties to the Convention and so will enrich the climate change debate.
- CDM projects will have positive impacts on the overall sustainable development of Parties to the Convention.

Though these benefits, there are likely problems that will emerge due to the introduction of CDM. These problems are:

- The percentage contribution of CDM credits to the overall commitments of Annex 1 Parties will be a key issue for negotiation. This will be very important in deciding if the overall objective of UNFCCC will be met.
- CDM will increase the administrative burden of Parties to the Convention.
- Countries with a weak private sector will find it difficult to participate in CDM projects.
- Monitoring and verification of credits at both national and international levels will prove difficult, especially given the varied nature of possible projects.

An Enabling Environment for CDM

As mentioned earlier, CDM projects should be compatible with a country's overall national development and environmental priorities. Therefore to participate in CDM Parties need a well-articulated list of development and environmental priorities. There are many developing countries that lack such information, especially within Africa.

In addition, non-Annex 1 Parties need to develop some basic capacities and a well-organised business environment for effective involvement in CDM. More specifically the following aspects are needed:

- A very strong regulatory framework that is transparent, enforceable and clearly defined. This would include a complimentary arbitration system.
- An established business environment (including an effective banking system, insurance companies and stock market.)
- An organised and accessible project information database that can provide information to local and external investors.
- An organised and co-ordinated public institutional framework.
- An adequate and well maintained public infrastructure (energy, water and transport.)
- A critical mass of experienced project developers and business managers and strategists.
- A critical number of small and medium scale local firms capable of exploiting market niches and sub-contracting at acceptable standards.
- Strong and effective partnership links between government, private sector and NGOs.

Within this enabling environment, non-Annex 1 Parties must develop suitable and adequate strategies that will assist them to exploit the opportunities of CDM. Such a strategy should aim at maximising the possible benefits while considering the constraints and available resources.

Conclusions

As an implementing mechanism of the Kyoto Protocol, CDM can create significant technology and resource flows to developing countries including those in Africa. However, African countries must create an environment for accessing the available benefits. At the international level, the drive for flexible mechanisms to work will increase, as all indications show that GHG emissions are increasing for all countries except those of the former Soviet Union. Records show that carbon emissions reached a record high of 6.3 billion tons in 1997 and the atmospheric CO_2 concentration increased to 364 parts per million. Also, the last 14 years have been the warmest since records began in 1866.

There are, however, signs that the use of more climate-friendly energy sources is growing. While growth in fossil fuels except gas has been increasing by 1% annually, wind energy has been growing by an average of 26% since 1990 and the growth of solar cells was 43% in 1997 alone (World Watch, 1998). Therefore, with a suitable structure in place and the institution of appropriate policies and measures, CDM has the potential to succeed.

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CDM Baseline and Additionality in the African Context - The Issues

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Introduction

In terms of combating climate change, it is irrelevant where greenhouse gas emissions are reduced. Hence, Article 12 of the Kyoto Protocol, which introduces the Clean Development Mechanism (CDM), allows governments or private entities in industrialised countries to implement emission reduction projects in developing countries in order to meet their emission reduction objectives. The industrialised countries receive credits for these projects in the form of 'Certified Emissions Reductions'(CERs).

The purpose of the CDM is to promote sustainable development while contributing to the objective of the Framework Convention on Climate Change (UNFCCC). For developing countries, particularly Africa, such a mechanism could provide an additional source of funding for projects for sustainable development, and such a prospect is welcome in principle. However, the extent to which the CDM could be operationalised to achieve these dual objectives of promoting sustainable development and reducing GHG emissions is the issue that remains unresolved.

Of immense importance and significance in this debate is the determination of emission reductions from a CDM project in the host country. Such a determination can only be made with reference to a pre-determined emission baseline(s). The extent to which a project is considered "CDMable" depends on the level of emission reduction that can be achieved with the implementation of the project. That also depends on the baseline and the performance of the project to a large degree.

Many have predicted doom for CDM in Africa, and there is a generally prevalent view that it will be difficult not only for Africa to define an economic baseline but also to compete for CDM projects. These two issues are interlinked, primarily because the failure to define a baseline indicates a significant lack of direction and effectiveness in the economies of Africa, such that the platform from which to launch CDM projects is questionable.

It may be argued that an economic baseline may not be critical if we adopt a project baseline approach. But indeed no project operates in a vacuum and an economic baseline becomes necessary in any case. A general baseline perspective for Africa is given in this paper to give an indication of possible economic and emissions trends. While it is accepted that such a continent- wide baseline is of no practical use in deciding CDM activities, it remains imperative that Africa should have a common perspective on which to base its global negotiations and formulate a common framework for participating in CDM where this is practical or necessary.

This paper also makes an attempt to discuss two of the main issues in the CDM debate. First, what to include in the baseline and second, the additionality issue in the context of baseline development. Both these issues are critical to determining benefits for the host country, the investor and the environment.

An overview of Africa's Economic Situation

The present economic conditions in Africa in terms of Gross Domestic Product (GDP) and economic growth rates are depicted in Table 1. An examination of the figures shows that African countries can generally be grouped into three categories: high growth countries (with GDP growth rates of 3%-10%), low growth and stabilising countries (with GDP growth rates of 0-3%) and lastly, declining countries (with -5.4 - 0% growth rates). These figures are significant as they play a major role in the projection of baseline GHG emissions.

In terms of economic outlook, the International Monetary Fund estimates a short-term economic growth rate of around 5.5% for sub-Saharan Africa. This is an optimistic view given current rates which place only a few African countries above a 5% growth rate, the potentially negative effect of weak commodity prices and the heavy dependence of the region on commodity exports, high interest rates which depress new investment, poor performance in foreign direct investments (FDIs) and falling Overseas Development Assistance (ODA) inflows.

Table 1. Real Gross Domestic Product and Growth Rates for African Countries (US$m).

	Constant 1987 prices			Growth Average %	
Country	**1980**	**1990**	**1995**	**1980-1990**	**1980-1993**
Sub-Sahara Africa					
Angola	7812	7320		8.8	
Benin	1242	1703	2096	2.2	3.0
Botswana	813	2137	2693	9.9	9.5
Burkina Faso	1615	2280	2673	4.1	3.4
Burundi	806	1248	1139	4.2	3.6
Cameroon	7542	10446	9555	2.9	1.1
Cape Verde	120	266	316	5.7	4.9
Central Africa Rep.	1073	1224	1280	1.4	0.3
Chad	574	968	1080	5.8	5.0
Comoros	153	205	207	2.8	2.5
Congo	1505	2425	2415	3.2	4.0
Cote d'Ivoire	9570	10390	11309	0.2	-1.0
Equatorial Guinea		126	180		
Ethiopia	7834	8748	1.9		
Gabon	4279	4487	5090	0.8	0.1
Gambia	169	248	269	3.0	4.0
Ghana	4654	5791	7166	2.8	2.7
Guinea	2355	2823			
Guinea-Bissau	121	197	229	3.7	4.6
Kenya	6159	9232	10005	4.2	
Lesotho	326	490	651	1.8	2.7
Liberia	1265				
Madagascar	2708	2849	2792	0.5	-0.1
Malawi	1052	1310	1426	3.3	2.9
Mali	1764	2200	2510	3.8	1.5
Mauritania	811	945	1145	0.6	1.8
Mauritius	1252	2250	2855	6.4	5.9
Mozambique	1574	2061		-1.5	-0.2
Namibia	1849	1966	2491	5.4	1.7
Niger	2544	2379	2479	-1.3	-1.4
Nigeria	26385	29880	34196	0.2	1.8
Rwanda	1756	2199	1337	1.0	1.4
Sao Tome & Principe	54	57	61	-1.5	-2.6
Senegal	3667	4981	5324	3.0	2.3
Seychelles	223	308	346	3.2	3.9
Sierra Leone	828	915	707	0.9	0.6
Somalia	818	988			1.1
South Africa	75684	86869	90156	1.5	1.1
Sudan	14653	16460			
Swaziland	410	652	720	4.5	4.1
Tanzania	3885	4589		2.3	2.7
Togo	1240	1385	1306	1.8	-0.5
Uganda	7677	10675		4.1	
Zaire	6514	7093	4805	1.6	
Zambia	2155	2372	2309	0.7	1.0
Zimbabwe	4417	6161	6375	2.6	3.1

Source: (UNDP 1993-6)

IMF growth assessments for selected countries are indicated in Table 2.

Table 2. Growth Projections for Selected Economies in Africa.

Growth Projections: Selected economies (IMF)					
	GDP $ billions	Growth rates Weight %	1995	1996	1997
			Percent per annum		
South Africa	125.0	48.0	3.3	3.0	2.0
Nigeria	30.0	11.5	3.8	3.2	3.7
Cameroon	8.7	3.3	5.2	3.5	3.5
Ghana	7.3	2.8	4.5	5.0	5.0
Kenya	6.6	2.5	4.9	4.0	4.0
Zimbabwe	5.4	2.1	-2.7	7.0	6.0
Botswana	40.0	1.5	3.1	5.0	6.0
Uganda	3.7	1.4	8.5	6.0	6.0
Zambia	3.2	1.2	-3.8	2.5	3.5
Tanzania	2.7	1.0	3.5	4.0	4.5

Sources: Economist Intelligence Unit (1997) and own estimates

Commodity prices are set to decline in the near future. The Economist Intelligence Unit predicts falls of 17% in the short term. A 6% fall in non-fuel commodities is expected, as is a 12% fall in metal prices. Investment in the region has been relatively strong. In the 1970s, Sub-Saharan Africa invested 26% of GDP. This was higher than the developing country average of 22.4% and higher than the fast growing Asian region, which averaged 24.6%. This investment drive has fallen to a present (mid 1990s) level of 16.3%. The World Bank considers this too low to sustain existing capital stock, which requires replacement investment of about 13%. Most of the investment has been in public sector infrastructure building. Private sector investment has remained at about 10% of GDP. A preferred level would be 20% (Standard Chartered Bank African Quarterly Review, 1997).

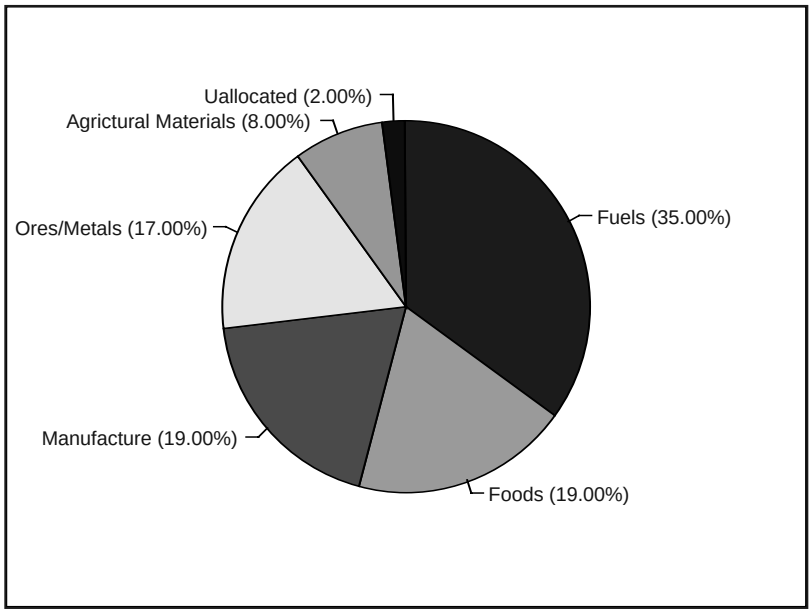
Local private capital will remain focused on maintaining present operations under the very difficult current economic conditions. Expansion is depressed by high interest rates, which are over 35% in most countries in the region. Foreign direct investment is also on the decline and will not help local drive. Most foreign investors are withdrawing from commodity-dependant investments or countries due to poor prospects in the commodity market. FDI was around 6.6% in the first half of the 1980s and had fallen to 3% by the mid-1990s. Access to FDI therefore fell from 26% in the 80s to only 6.7% in 1995 (Standard Chartered Bank, 1997).

Privatisation of the major parastatals, mainly in transport and electricity, may have a positive impact. This is critical if a new window of investment is to be opened. Already, only a few of the power utilities in SADC, for example, can support their new investment requirements. Between 1988 and 1992, foreign investment in privatisation programmes totalled less than US$ 1 billion. More than half of this was in South Africa alone - indicating that while averages may look good, some countries are quite unlikely to attract investment at all. In 1993-94,

FDI privatisation inflows rose to US$1.4 billion but concentrated mainly on Ghana, Zimbabwe and Zambia. Other countries have active privatisation programmes but the success rate of these remains to be determined.

Already, countries have shown very limited capacity to provide funds for expansion investment. Zimbabwe has already indicated that it will only be able to provide less than a fifth of some US$2.4 billion infrastructure investment needed over the next five years, leaving US$2 billion to come from the private sector. In an atmosphere of FDI withdrawal from commodities and infrastructure, this will be a hard goal to achieve, particularly as ODA inflows decline.

Africa's export markets are declining as indicated due to commodity dependency. Harsh foreign market conditions and declining exchange rates coupled with the traditionally poor commodity terms of trade very much limit Africa's expectations of raising investment financing through exports. One way forward would be to break into fast growing sectors such as tourism and software (as opposed to commodities and infrastructure). Africa's exports of manufactured goods are only 19% of total exports compared to 54% in industrialised countries. Present export distribution (UNCTAD, 1996) is indicated in Figure 1. The prospects for industrialisation are not very bright.



Source: UNCTAD, 1996

Figure 1. Distribution of Sub-Saharan Africa's Exports by Source.

Africa's share of global manufacturing production fell from 6% in the 1970s to 3% in the 1990s. This level is expected to remain static for the next 10 years. Other developing regions have a 24.3% share, having risen from around 15% in the mid 1980s. (UNCTAD, 1996).

Baseline Economic Trends

Despite the difficult conditions indicated in the preceding section, it is realistic to at least assume that Africa will achieve positive economic growth rates. What level these rates will be is subject to the various factors discussed earlier. On a general scale, we have assumed that growth will be within the range of the present achievements shown in Table 1 above, and the IMF assessment of 5.6% per year will be achieved. These averages hide the huge disparities in GDP growth rates in the region. They may be more realistic when one looks at regional or sub-regional projects, but at the country level, the story could be different. Based on these assumptions, we have projected economic growth patterns. These are shown in Table 3 and depicted graphically in Figure 2.

Table 3. GDP (US$) Projections.

	Using Current Growth Rates						
	1995	2000	2010	2020	2030	2040	2050
Total	417333	430694	619785	845784	1216183	1860496	3060596
	Using growth rate of 5.6%						
	1995	2000	2010	2020	2030	2040	2050
Total	474020	502447	1071904	1850950	3191786	5503931	9491004

Source: Own estimates

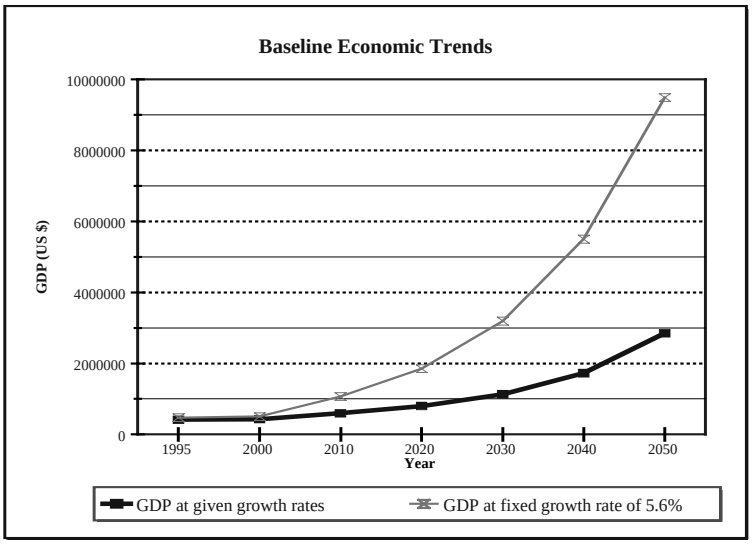


Figure 2. Baseline Economic Trends graph (Based on table 3)

The energy sector has been chosen as an example to highlight the issues presented above. We begin with an overview of the energy sector and proceed to analyse CDM effects on the energy sector baseline.

Energy Consumption for Africa

The baseline energy consumption under these economic trends is indicated in Table 4.

Table 4. Baseline Energy Consumption for Africa (10^6 GJ)

	Scenario	
Year	**1**	**2**
1995	32600.51	32600.51
2000	31482.35	36829.44
2010	43723.30	78570.56
2020	58508.06	135674.60
2030	83076.17	233957.90
2040	126540.30	403438.10
2050	208994.70	695690.60

Scenario 1: GDP (million US$) at 1980-1993 growth rates
Scenario 2: GDP (million US$) at fixed growth rate of 5.6%

Based on (Lennon, undated)

Energy consumption trends in Table 4 represent expected baseline energy consumption patterns assuming the 1990 energy/GDP relationship. This relationship was calculated using assessed energy consumption for Africa in 1990 and the total African GDP in the same year to obtain an indication of the energy intensity of economic activity. This relationship was varied for the projection period based on WEC assessments of energy demand in the year 2050. In the first scenario presented in the table the GDP base of the energy demand trend was calculated on the average GDP growth rate between 1980 and 1983, while the second scenario was pegged on a GDP growth rate of 5.6%.

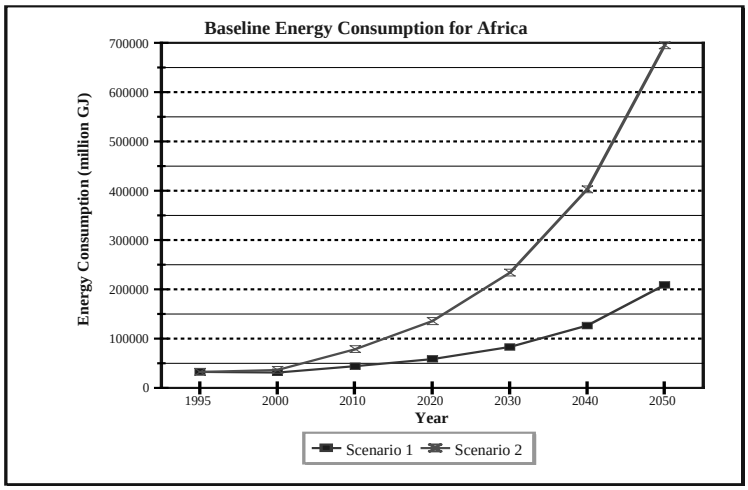


Figure 3. Energy Consumption for Africa.

Basic data for WEC assumptions is presented in Table 5. This forecast includes all fuels and offers a reasonable alternative demand scenario, on the basis of which we have calculated the alternative emissions path shown in Table 6.

Table 5. WEC forecast of energy demand in Africa.

	Primary energy consumption, Mtoe				
	1990	2020		2050	
Scenario		A	B	A	B
	287	694	663	1719	1394
Coal	85	216	180	656	425
Oil	41	116	170	100	216
	4	20	17	146	113
Nuclear	2	0	3	0	78
Other	156	342	294	818	561
Non-commercial	147	176	185	205	220
Hydropower	9	21	18	87	33
Biomass	0	133	82	502	201
Solar	3	0	45	45	45
Other					
Renewables	0	8	8	63	63

Source: *Global Energy Perceptions to 2050 For Africa*
Note: *Subtotals may not add due to independent rounding*
Scenario A: *Positive climate impact of coal - no incentive to reduce coal usage*
Scenario B: *Modest economic growth and technological development pragmatic with slow growth in Africa*

Baseline Emissions

Two baseline emissions scenarios were developed, each with two possible paths. The first scenario shown in Table 6 and in Figure 4 represents an emissions trajectory based on WEC assessments of future energy demand.

Table 6. CO_2 Emissions for Africa (based on WEC Energy Demand Projections) (Lennon, undated)

	1990	2020	2050
Scenario A:	44263	116087	249771
Scenario B:	44263	85554	127153

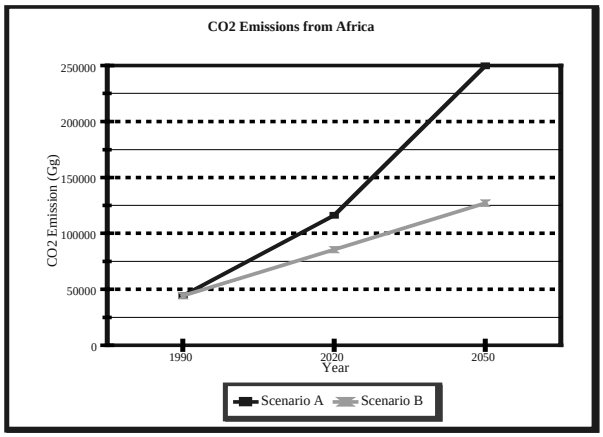


Figure 4. CO_2 Emissions for Africa based on WEC Energy Demand Projections. (Lennon, undated)

The second scenario, Figure 5, is based on emissions assessments pegged to our projections of African economic growth but including WEC assumptions on energy demand.

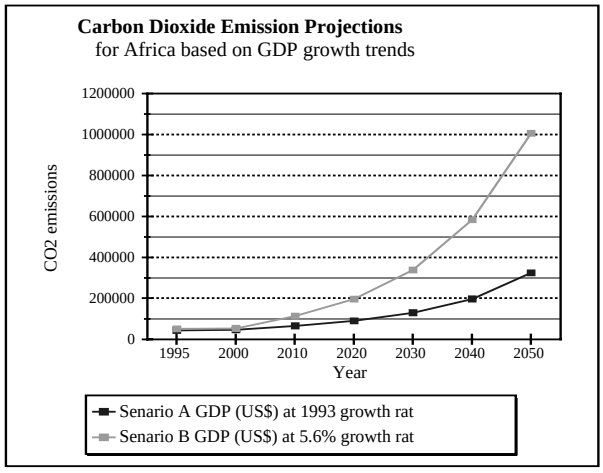


Figure 5. CO_2 Emissions for Africa based on GDP Growth Trends

The economic and emissions background presented above calls for a systematic analysis of the departure from baseline conditions to a CDM path. In the next section, we discuss some methodological issues relating to such an analysis, issues related to the various possible definitions of baselines as well as issues pertaining to additionality.

CDM and Baselines: Methodological Issues and Their Implications

In our framework for the African baseline, we simply made our best guess as to economic development trends, made assumptions about the technology mix in the economy (this was left static at the mid 1990s level), assessed the energy usage and the carbon intensity of energy, then projected future emission trends. This is straightforward. What would be more interesting from a methodological point of view is what we would like to suggest as "*rolling baselines.*" This concept suggests that a baseline made for one planning period cannot be assumed to remain static. It will naturally change and will in fact be influenced significantly by what we can call the 'CDM push' on development. That is, successful CDM projects should raise the planning platform and assumed capabilities within a country such that an exponential increment in economic activities is realised, leading to a relative exponential change in baseline assumptions. This is presented graphically in Figure 6.

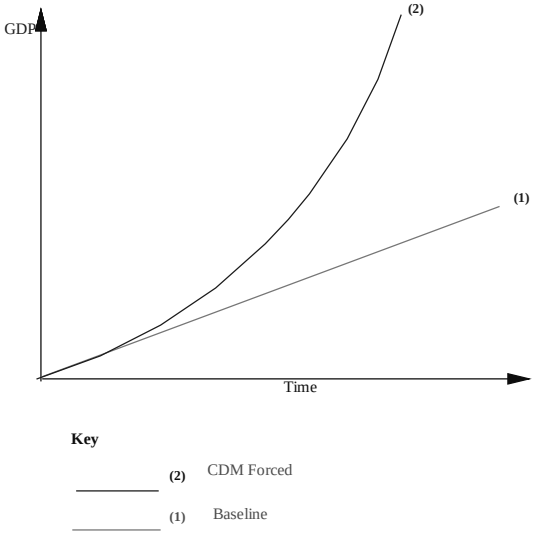


Figure 6. Exponential Forcing of CDM on Economic Expansion Trends

This forcing effect should have an impact also on the rate of increase of total emissions in the country. It will certainly have a dampening effect on the unit emissions of economic activities. Figure 7 shows clearly that the lowest path (CDM unit emissions) has a general downward tendency while the total emissions path (CDM emissions) has an exponential upward tendency.

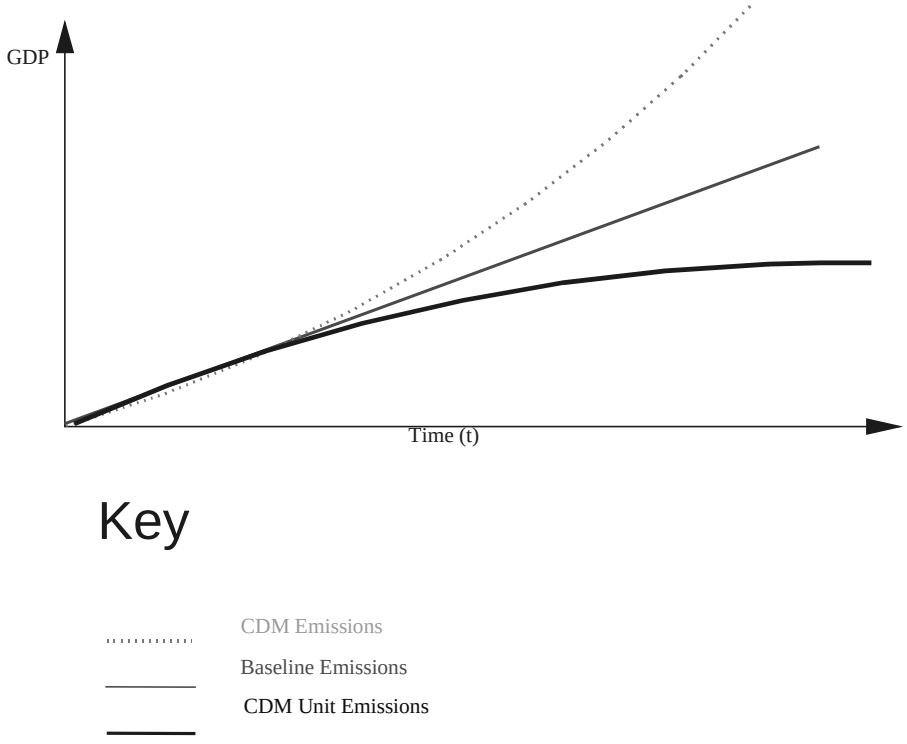


Figure 7. Effect of CDM Exponential Forcing on Emissions

With these assumptions, the baseline development tendency for Africa should change dramatically. A reduction in total emissions would therefore not be realised but a reduction in unit emissions will be realised with the overall effect that economic goals will be achieved much earlier and cumulative emissions totals will build up much faster, perhaps achieving their limits over a much shorter period of time (see Figure 8). The desired tendency is that the African long-term path coincides with and does not overshoot an agreed global limit. This should be the sought after effect for CDM collaboration.

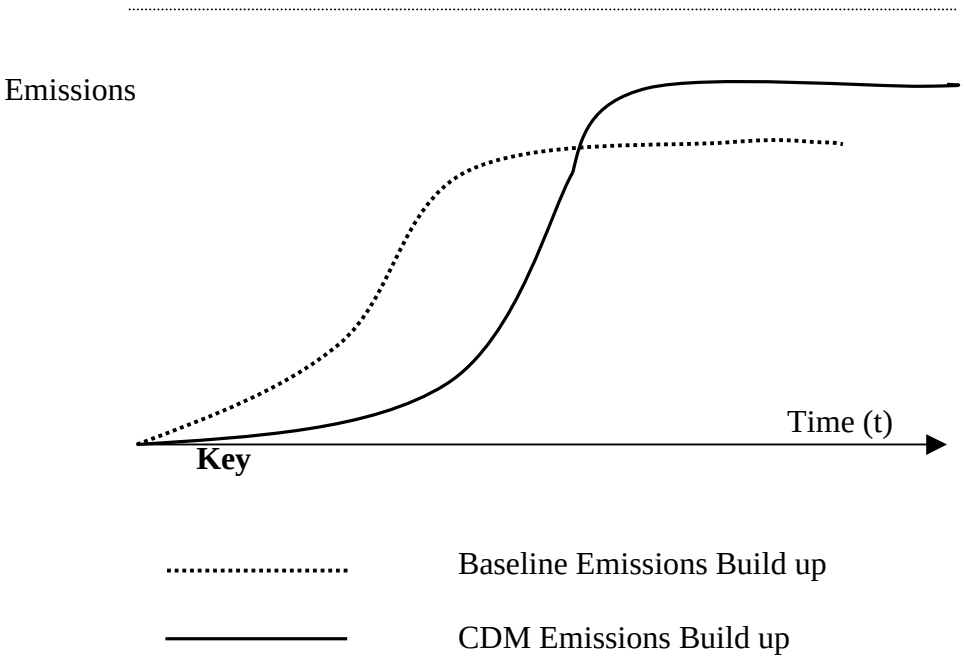


Figure 8. Effect of CDM forcing on cumulative build up of Emissions

National versus Project baselines

It has been stressed that reduction in emissions from CDM projects must be 'additional' to what would have otherwise occurred. To assess CDM projects, a project baseline seems to be the logical choice. Emission reductions are calculated from the difference between two emission levels - project baseline and project performance.

A monitoring mechanism must be established in the case of a CDM project. In the preparation of national communications, countries have focused on high GHG emitting sectors in the national economy. Projections of emissions have been based on GDP and population growth rates, among other factors. In many of the mitigation studies done by countries in Africa, GDP growth rates have been one of the parameters used in projecting GHG emissions. However, one has to be careful in the choice of GDP growth rates for countries that are experiencing low economic growth and those where growth is in decline. Any choice of optimistic GDP growth rates could overshoot the estimation of the GHG emissions from sectors and make CDM projects for GHG emission reduction more attractive than they should be. That is

why it is important for all the actors to agree on realistic growth rates for the projection of GHG emissions.

Baselines have been developed based on different sets of assumptions. Among these assumptions are no change in the level of activity (assuming static energy/heat consumption) and continuation of present trends (assuming declining carbon stocks or unsustainable energy consumption patterns and that there would be no technological advance or energy efficiency improvements in the absence of CDM). It is obvious that the national baselines consist of a basket of projects.

However, in a regime where emission reductions from GHG mitigation activities need to be meticulously estimated, verified and certified, would national baselines be useful for such purposes? This is an unresolved issue. In the context of CDM, it is being contended that setting of baselines on a project-by-project basis is probably necessary to ensure verifiability. Project related baselines also represent a number of assumptions, which must be set ex-ante before project evaluation and acceptance. Developing countries have no emission targets, so the most realistic way to eliminate the exportation of counterfeit emission reduction units is developing a project specific baseline.

There are important issues to consider in the project approach. Are global environmental and for that matter national economic benefits greater if we intervene at single project level or if we put together a basket of interrelated projects that approach a national programme, or indeed a regional programme where resource sharing is a natural reality? Will the total amount of benefits be discrete summations of gains from individual projects or do we expect that the simultaneous interface of projects in the basket will alter the structure of benefits? This is a difficult methodological question but the latter tends to be true. In practice, however, this challenge is real. For the host country, the basket approach will occur as a matter of course while for investors, the discrete approach is also a matter of course. Do the analytical approaches of the various parties tally? The global accounting officer (ie the secretariat) will see discrete sums, while the national accounting officer will see synergic impacts on national benefits. How can these two be reconciled?

Concept of Additionality

Article 12 of the Kyoto Protocol provides for the exchange of ‘certified emission reductions’ between Annex 1 and non-Annex I countries under the newly defined CDM. This carbon-offset mechanism is specifically defined to support sustainable development while helping Annex 1 countries comply with their commitments under the Protocol.

For projects under the CDM to be certified, they have to result in “reductions in emissions that are additional to any that would occur in the absence of the certified project activity” (Article 12.5 (c)). Determining additionality is inherently complicated. It essentially involves a response to the question: What would have happened in the absence of the project proposed for credit? While this can be quite complicated, it is crucial to the integrity of the CDM. Thus the main issues with respect to additionality are how to define the term and how to apply the additionality test to proposed CDM projects.

Additionality has been defined differently by various groups. Environmental groups, such as the Worldwide Fund for Nature, argue that for a CDM project to be eligible for credit it must achieve reductions that (1) go beyond reductions that would have occurred as a result of the project sponsors meeting their existing obligations, and (2) result in emissions reductions beyond those which would have happened anyway, for other reasons. Further, the project must be undertaken principally to reduce or offset GHG emissions. Most Annex 1 countries consider this definition of additionality to be too restrictive, and would rather define it less restrictively. No matter how one looks at it, the way the COP and CDM Executive Board define additionality will have important implications for the magnitude of future investment flows under the CDM. Generally speaking, the additionality test must be seen to be balancing the objective of encouraging private sector investment with that of ensuring that the vast majority of projects earning emissions reduction credits are delivering real reductions.

The additionality debate led to a question from the G77 and China as to how it will be ensured that project activities under CDM do not replace ODA. In other words, investments in CDM projects should be additional to ODA, and GEF funding. This concern of the G77/China is closely related to two other issues emerging from the discussions on additionality. These are financial and environmental additionality. Financial additionality has been defined as financial investment aimed primarily at emissions reduction rather than at some other income-producing purpose such as electricity supply. It refers to the financial flows of a project, posing the question of whether the expenditures involved would have been made without the offset project. It also implies that financing of CDM projects should be additional to GEF and bilateral official development assistance (ODA) funding in developing countries. Environmental additionality has also been defined as a project that must achieve emissions reductions over and above those that would have occurred 'anyway', i.e. without the project. Having made these points, many analysts have different opinions on how these definitions should be interpreted and applied.

Concluding Remarks

The paper has partly sought to give a context to the discussion on the methodological and conceptual issues on the CDM and partly raised issues that are likely to be encountered in implementing CDM projects in Africa. One of the thorny issues is the determination of baselines. Setting baselines for CDM is important in order to provide a basis for judging additionality and distributing benefits. In the paper we suggested project-based baseline as the possible way forward, however, there are very serious unresolved issues such as:

- Should the period for baseline projection conform to the project life span or the planning horizon consistent with the country's development programme?
- In the situation where there is a conflict between project duration as perceived by the country (planning horizon) and the private investor (project life span), how can this be resolved?
- Each project has its own specific elements, and as a result each project baseline must incorporate these.

We hasten to add that various baseline approaches can be adopted but each will have different effects on the objective of increasing the value of additional benefits. For CDM to be effecti-

ve, the forcing effect on the rate of development in the host country has to be very strong. Otherwise the effect will not be felt and the gains from CDM will be minimal.

Our discussion in the paper also fails to allude to the critical issue of what additional benefits a host country should be looking for. Africa is a very difficult host region case because its interests still lie in the infrastructure sector and guest investors do not appear to be focusing on these sectors. Africa is still seeking expansion of the manufacturing sector and in this regard presents a good technological host, as it is not committed to any serious sunk technology burden. However, there is a global investor transition to the "software" sectors such as Information Technology and the capital goods sector, where Africa has yet to make an impact.

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Participatory Implementation and Governance of Clean Development Mechanism (CDM) Projects in Africa

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Introduction

The need for global cooperation towards the attainment of sustainable development has been very crucial in the light of the current bipolar acrimony between the developed countries (who have the greater percentage of the financial, technical and managerial resources) and the developing countries (who have the greater percentage of the natural resources). Since most of the global environmental problems are alleged to be created by the "myopic" economic development paradigm in the developed countries that treats the environmental cost of development as externalities, the developing countries have made several contractual demands, the fulfillment of which will be essential for stimulating their cooperation towards compliance with multilateral environmental agreements and global response to environmental crises.

The Clean Development Mechanism (CDM) established by Article 6 of the Kyoto Protocol is the current major mechanism of resource transfer instituted for meeting the contractual demands of the developing countries. Prior to the establishment of the CDM, the Global Environmental Facility (GEF) which funds the incremental cost of projects with global environmental benefits and the Activities Implemented Jointly (AIJ) were mechanisms for meeting developing countries' demands. The status appraisal of GEF and AIJ by developing countries, their limited scope of operations, their lack of adaptability and capability to meet the emerging new patterns of financial demands, logistical support and cooperative fulfillment of UNFCCC commitments, and the performance of their projects-based operations necessitated the establishment of the CDM.

This paper believes that, lack of universality in the participation and implementation of GEF and AIJ projects are some of the reasons for their poor performance. The GEF and AIJ/JI locus of mandate are too restrictive (only the Implementing Agencies and national Governments have mandates), and their ambit of participation are too narrow while paradoxically their scope of operation and partnership are so broad (GEF funds projects from four focal areas of climate change, biodiversity, international waters and ozone layer, while AIJ/JI funds project-based offsets from both developed and developing countries). Financial mechanisms with such structure will certainly lack the adaptability and receptibility to address even all their focal issues. Addressing future emergencies will simply be overwhelming. The gravity of the demands articulated by the developing countries during the UNFCCC negotiation process, the deluging number of projects submitted for funding and the inability of GEF and AIJ/JI to meet these demands provides credible evidence to this assertion.

The CDM provision avoids the broad scope of GEF/AIJ by limiting the scope to only climate-change related projects with "certified emission reduction" (CER) and project partnership between developed and developing countries. Thus, appropriately designed and implemented the CDM promises to make a decisive contribution towards developing countries developed countries cooperation in the quest for environmental objectives. More specifically, for African countries, the CDM has the potential to contribute, decisively, to their quest for sustainable development. The ability of the CDM to live up to its promise---in Africa, but also elsewhere-- however, will be dependent upon the extent to which the process can ensure the participation of the major stakeholders in its design and implementation.

Why is there a need for universality of participation in the design and implementation of CDM projects in Africa? Who are the major stakeholders whose participation will be important? How can these stakeholders be incorporated into the CDM? The purpose of this paper is to answer these questions. More specifically, we suggest devolution of mandates to other stakeholders that will expand the conduit for the resources and the dynamism needed to achieve the socio-economic and environmental objectives of the CDM in Africa. To do so, we begin by examining the conceptual basis for the inclusion of stakeholders. Next we identify what we believe to be CDM stakeholders in Africa. Finally we propose a framework, based on the anticipated CDM project cycle for participatory implementation and governance of CDM projects in Africa. What emerges most forcefully from this article is the conclusion that the success of the CDM will depend on its ability to attract and incorporate stakeholders whose interests will keep it going.

The Conceptual Basis for Mandating other Stakeholders of the CDM

Presently, under the governance provision of the CDM, the Conference/Meeting of the Parties (COP/MOP) has been mandated to guide the process of institutionalizing the operation of the CDM. But the task of determining projects which could be eligible, the determination of the part of commitments which could be fulfilled from project with CERs, project design and funding, monitoring, evaluation, the establishment of entities to certify emission reductions of projects, and the dissemination of information on CDM projects undertaken by over 150 developing countries will deluge the administrative, logistics and financial capacity of the COP/MOP/EB.

African countries will also face the enormous task of screening projects based on the eligibility criteria of the CDM, designing projects to be consistent with national development objectives, monitoring projects, designating or creating accreditation and certification agencies, the registry and evaluation of CDM projects. Involving other stakeholders of CDM projects will substantially reduce the administrative cost for the government and help tap resources from other non-governmental sources.

To ensure integration of CDM projects with the projects of other institutions; to make CDM projects consistent with development goals, to create the possibilities for sharing experiences, skills, and technology; to avoid the duplication and waste of financial and material resources; to ensure cost-effectiveness of projects and to cut down administrative costs of CDM, Certain mandates should, therefore, be given to institutions who are stakeholders in CDM objectives and are currently undertaking related task.

Secondly, with the decline in the overseas development assistance (ODA) from the developed countries due to the enormous financial and institutional task of restructuring their technology to make it more environmentally-friendly, it is doubtful if their current level of commitment can be sustained to ensure continued financial contribution to finance development projects in the developing countries. This may demand the search for alternative sources of funding. Financial institutions provide some of the avenues for mobilizing additional funds for CDM projects.

Moreover, the incremental cost incurred by undertaking a CDM project will not only involve the prevention of environmental degradation that might be associated with the construction or initiation of a project but will also entail monitoring and control of future unexpected occurrences that might distort the attainment of the expected CERs. Thus, the CDM projects must look beyond immediate environmental benefits (CERs) to anticipating and preempting future environmental effects, improving the production and process efficiency of the projects, and enhancing their cost-effectiveness to prevent any future collapse of the projects due to lack of viability.

This will require some aspects of profitability other than “certified emission reduction” to make the projects generate self-financing capacity and to encourage the contractual donors to contribute to finance related future projects. Besides this, the profitability of the projects will motivate the adoption of cost-effective policies and measures that will promote the pursuit of better administrative and institutional settings to address any future tasks. The profitability of the projects will also attract financial institutions and the private sector that have the skill, training, facilities and the technologies to get involved. This case becomes more forceful when we consider that, presently, financial institutions are exploring the modalities that will make them finance only “green” projects and for the fact that, the flow of private investment to the developing countries have increased significantly over the flow of ODAs (Shmidheiny, 1992).

Furthermore, financing CDM projects will not necessarily lead to the attainment of emission reductions. The major problems in the developing countries causing environmental degradation are not only a lack of public funds for financing environmental projects. They are activities related to the poor living standards, lack of alternative sources of employment and income, maximization of private benefit without any concern for the social cost, as well as policy and market failures. Besides, financing CDM projects per se will not contribute significantly to

maximizing CERs if the projects are not structured and operated in a way that address other socio-economic elements that will affect the viability of CDM projects.

These observations call for the expansion of the umbrella of participation and the search for modalities that will ensure partnership, mobilization and coordination of the activities of other institutions who are stakeholders in attaining the anticipated goals of CDM projects in Africa.

CDM Stakeholders

The CDM projects are to be established by a partnership agreement between public or private agencies from Africa and Annex I countries; the local community where such projects would be established should not be ignored. The needs of the local community where the project is to be established must precede any global considerations. That particular project would not have been conceived if the need of the community had not been identified first. The project must therefore be patterned in a manner that could ensure the satisfaction of those local needs. Implicitly, the fundamental objective of any CDM project is not the attainment of the expected CERs. The attainment of the CERs must be contingent upon the attainment of the fundamental objective of the project. For this purpose, the target group(s) that made the fundamental objective of the CDM project relevant must be identified. The community that the CDM project was originally meant to benefit is therefore a stakeholder. The community should be involved and encouraged to contribute its quota for the realization of the entire objectives of the project. It has been noted that project-based operations lack community participation though such projects are originally meant to serve the needs of the community (Guidi et al., 1993; Werksman, 1994).

While there has been a persistent fall in ODA from OECD countries, private investment has been rising steadily in particularly South East Asia and Latin America. According to a World Bank report (1995), the flow of private investment quadrupled between 1986 and 1994 reaching about US$ 170 billion a year. In Africa the flow of private investment is relatively negligible. Frameworks that minimize governmental control of production, low bureaucratic hurdles, economic benefits and sustainable development of local resources should be established in order to attract direct foreign investment. Of course this will make the adoption of democratic regimes attractive when its realized that private investment is directed towards regimes with democratic governments. Projects which provides encouraging economic incentives while maximizing the environmental benefits will attract multinational corporations to rationalize their corporate management objectives towards the attainment of CDM objectives in Africa.

It is anticipated that some of the CDM projects would be funded from financial resources borrowed from the Multilateral Development Banks (MDBs) and Regional Development Banks (RDBs) like the African Development Bank. This makes MDBs and RDBs stakeholders in CDM projects. Since such funds are normally provided on terms similar to those in the international financial markets, the economic objective of the projects will be prioritized at the expense of any environmental benefits. Incorporating these financial institutions that are stakeholders in CDM projects is very essential. The CDM projects cannot attain their environmental benefits if the decision-making processes of these institutions are not directed towards sustainable development.

Other interests groups like environmental NGOs are also stakeholders in CDM projects by virtue of their interest in ensuring development and preservation of the environmental integrity in the community where the project is sited. The participation of NGOs in CDM projects should not be hindered by African governments. Grassroots organizations and local organizations operating at the informal sector in African countries should also be mobilized, and capacitated to achieve their greater participation. Academic institutions in Africa could play significant role in the evaluation, certification, verification and monitoring of CDM projects and need to be involved in the outset of the projects.

Framework for Participatory Implementering and Governance of CDM Projects in Africa

The CDM is a project-based mechanism so it is anticipated that the cycle of operation would principally involve project development, project monitoring, and project certification, auditing and verification. The case for the devolution of mandates to other stakeholders will be presented in a framework based on the project cycle where mandates could be given to other non-governmental stakeholders to perform specific tasks. The effective realization of cooperative implementation may demand the identification of the particular pattern of project involvement based on the unique characteristics and resource capacity of the stakeholders at a specific stage of the project cycle.

Project Development and Implementering

This basically involves project identification and assessment, project design, and preparation, project funding and operation. The project identification and assessment phase must involve the assessment of both local development needs and the global environmental benefits. The local community or the target group of the project have to be involved in a rapport in order to clarify the focus and objectives of the projects. The NGOs mostly work with the local communities, so their role of initiating such a dialogue with the governmental agencies that are receptive to indigenous perspectives and skills should be encouraged. When the local community is involved in the project identification and streamlining the objectives of the projects towards the attainment of sustainable development, the probability of considering the project as an external imposition will be reduced. Involving the local community in a rapport with the governmental agencies in Africa or the key partners of the project will thus stimulate their active participation in realizing the goals of the CDM projects.

Since local resources like land, labor and natural resources will be utilized in the project, involvement of the local community will also arouse their willingness to contribute towards the materials and resources needed for the project. When CDM projects utilizes local materials and resources, it will cut the cost for expatriate remuneration and import expenditures that have to be financed by the limited foreign currencies available in African countries. Utilizing local resources will also result in the application of technologies that require minimal adjustment and learning period from the local users and make the projects more suitable to the needs, skills and resource availability in the local community. This will also help to avoid future breakdown of projects that are so common in Africa as a result of lack of spare parts and

personnel for maintenance, assembling and operation of the project and provide the effective medium for education, functional training and capacity building in Africa.

The national banks, private banks, rural banks, and the ADB and should also be involved in assessing the feasibility of the projects and for identifying reliable sources of funding separate from the CDM funding of the incremental cost. National Investment Boards should be mandated to explore and solicit projects from agencies in Annex 1 countries. A registry of CDM project could be established for bidding by prospective local partners. Lawyers organizations like the Lawyers Environmental Action Team (LEAT) in Tanzania should be empowered to assist local partners in drafting the investment contracts for CDM projects, educate them on the legal implications of joint investment and enforce the legal compliance of the investment contract. This will attract investments for CDM projects since external partners will have the guarantee of legal enforcement of investment contract which will minimize the chances of expropriation and unilateral abrogation of contract agreements. The lawyers' organizations could work in cooperation with traditional law enforcement agencies like the chiefs, and clan elders. Local and national scientists, as well as research institutions, should also be involved in the assessment of the negative externalities as well as the environmental benefits of the projects.

The project design phase must involve the tentative project planning and arrangements of the project. After the successful completion of the feasibility studies and the environmental impact assessments, negotiations should be initiated concerning the partnership agreements for the projects, contracting for additional financial and technical resources and the distribution of cost and benefits of the projects. This should be more encouraged in situations where the domestic resource capacity for ensuring the project viability and durability is inadequate.

The fact is, most African countries have projects that could benefit communities in diverse ways and also contribute towards the achievement of global sustainable development, but lack the necessary financial, managerial and technical resources for undertaking such projects. Private corporations and multilateral corporations should be mandated by the CDM to provide the additional resources and to stimulate their cooperation towards the transfer of sustainable technologies to Africa. It is appropriate to define the additional resources that will be available through such partnership and cooperation in the terms of the agreement. The provision of additional resources should not be defined by the principle of *"additionality"* but by principles that promote economic incentives and ensure the maximization of mutual benefits. The ADB with its regional expertise and international recognition could be mandated to leverage for additional financial resources to finance the projects.

The finalization of the project planning, contracting and partnership agreements undertaken during the project design phase should be undertaken by the consortium of stakeholders involved from the project assessment phase. The involvement of the consortium of stakeholders from the outset of the project will make available adequate baseline information and familiarity with local conditions that will contribute to effective implementation of the projects. The banks that were also involved in mobilizing additional financial resources and forging innovative partnership commitments must also be mandated to participate in the finalization of the contracts and arrangements undertaken during the project design phase. Since the project is also meant to benefit from the managerial, financial and technical capacity of the private corporations, they should also be mandated to participate at this phase of the project cycle.

To ensure that, the project fulfills its fundamental objectives regarding local benefits as well as the global environmental benefits, the project should be operated in a manner that enhances its cost-effectiveness, improves the production and process efficiency and control any anticipated environmental effects. When private corporations are mandated on equal grounds like the governmental agencies in CDM projects through the partnership agreements forged, they will ensure that the project is cost-effective by virtue of the fact that they are motivated more by economic interests. The private corporations have the capacity for devising physical and organizational structures that will contribute to the realization of the economic benefits of the projects.

Project Monitoring and Verification

It is anticipated that as their traditional practice the NGOs would be concerned about the local impacts of CDM projects as well as the realization of the expected CERs. Instead of the National Standard Boards undertaking the project monitoring NGOs who are more familiar with the local conditions and are actively involved in development programs in several localities should be mandated to monitor and report to the Standard Boards or any national certification committee that would be designated. This should be done in collaboration with the local community. Where the monitoring capacity is lacking, national governments should initiate programs towards training and capacity building to enable the NGOs and the local communities to serve as their local representatives and efficiently undertake the monitoring, reporting and dissemination of CDM project information. This will not only provide an avenue for participation by other stakeholders of CDM project as envisaged in the CDM provisions but will itself relieve the governmental agencies responsible for undertaking these task and make them more efficient in coordinating the activities of the projects.

Project Certification and Auditing

This stage will involve the certification of emission reduction from the CDM project (Cameron and Werksman, 1998). History of certification and regulation of production standards indicate that the National Standard Boards are exclusively given this mandate. But we have to consider the capacity of Standard Boards in African countries to meet the challenges of baseline establishment, auditing, certification and monitoring of project-based mechanisms in Africa.

For attractiveness of African CDM projects to agencies in the Annex 1 countries, the criteria, indicators, and standards used in the auditing and certification must conform to international standards. This calls for comparability and harmonization with African regional standards and international standards. African NGOs like Climate Network Africa (CNA), non-profit policy research centers like Center for Energy, Environment and Technology (CEEST), Southern Center for Energy and Environment (SCEE), African Energy Policy and Research Network (AFREPREN) and intergovernmental organizations like Environment and Development in the Third World (ENDA) and African Technology Center (ACTS) who are familiar with African conditions through their cross-country research and also familiar with international standards could play a very significant role in making African criteria and standard comparable with each other and with international standards. This regional workshop could itself provide the opportunity for establishing an African Regional Network for scientific cooperation and information sharing on certification, auditing, and verification.

If the traditional practice of giving the mandate for standards regulation solely to National Standard Boards is followed, this will constrain several opportunities which could be mobilized to facilitate reliable and credible certification processes in Africa. The validity and reliability of methodologies and indicators used in the certification of CDM projects in Africa will grant Africa a comparative advantage over other regions or at least make Africa competitively capable to attract substantial amount of CDM projects to the region. For this reason, national research institutions, academic institutions, and NGOs could be equally mandated with the National Standards Boards in choosing the appropriate methodologies, criteria, standards and indicators for certification of CDM projects in Africa. The participation of and independent certification by private institutions will relatively confer some degree of transparency, objectivity and reliability of certification in Africa. The participation of NGOs will facilitate the clarity and communicability of certification results to non-technical local partners and rural communities.

Summary and Conclusion

The paper has provided the demands articulated by the developing countries as their contractual commitment to multilateral environmental agreements like the climate change convention. It has also discussed sequentially the bargaining principles underlying the demands made by the developing countries which provide the basis for the institutionalization of the CDM.

Having established the importance of stakeholder participation in development in general, the paper offered a conceptual basis for the participatory implementation and governance of CDM projects in Africa. More specifically, it suggested the devolution of mandates to other stakeholders as a basis for making the CDM dynamically receptive and capable of addressing the anticipated mounting demands for project funding from Africa. Since the CDM provision itself anticipates future cooperation with some agencies, the paper provided a framework based on CDM project cycle to identify the phases where some of these stakeholders could be mandated to undertake certain tasks towards the realization of CDM project objectives.

The devolution of mandates to other stakeholders will not only tighten the obligation of governmental agencies and local communities towards the realization of sustainable development. Additionally, it will also facilitate the leveraging of additional financial resources from other sources through innovative mechanisms and stimulate the participation of NGOs, local and national scientists, private corporations, and regional development banks in CDM projects. In sum, it will provide the medium for forging effective partnership that ensure the convergence of interests and maximization of mutual benefits; encourage interdependence and realization of mutual interest with regard to sustainable development; become an active broker and bridge “builder” between African countries and Annex 1 countries, and ultimately, make projects both financially and environmentally sustainable and contribute to sustainable development in Africa.

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A Potential Modus Operandi for the Clean Development Mechanism as Proposed under the Kyoto Protocol

by

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Introduction

The Kyoto Protocol was a landmark development in the history of climate change, creating not only the precedent for binding emission reductions for developed nations, but also a mechanism which will enable cost-effective reductions to support sustainable development. The latter will become a possibility under the Clean Development Mechanism (CDM).

The Protocol is not prescriptive about the structure or process of the CDM, and there has therefore been much debate as to how the mechanism could operate and be structured in a way which promotes emission reductions as well as sustainable development and adaptation in developing nations. This paper is a contribution to the debate by proposing a mechanism which meets the sustainability and adaptation requirements of developing nations, whilst creating emission reduction and business opportunities for developed nations.

Potential Mechanism for Operation of the CDM

It is clear from the Kyoto Protocol that the currency under which the CDM will operate is the certified and verified emission reductions generated by endorsed projects. The credits can be used as a project funding mechanism, whilst at the same time allowing developed nations to offset them against their emission reduction targets.

A distinction needs to be drawn between Emission Reduction Units (ERUs), which are created under the joint implementation and emissions trading provisions of the Protocol (Articles 6 and 17), and CERs. This paper proposes that the major distinction is that CERs are the certified product of CDM projects, which may be transformed into ERUs once in the hands of a developed nation. The ERU may then be offset against the emission reduction targets as set

under the Kyoto Protocol. It could be argued that once an ERU has been offset against the targets, it may no longer be traded, however this becomes a difficult concept to apply in practice. It should however be noted that CERs are a useful trading unit as they could be owned by any party – developed or developing, private or public sector. This also creates the opportunity for developing nations to become voluntarily involved in emission reduction projects. Obviously for this to happen the CDM needs to operate in such a way as to enable entities in developing nations to own, accrue and trade in CERs. Under the model presented here, developing countries may sell their CERs to the CDM Agency at any stage, whereupon they may be sold on to developed nations (private or public sector) to become activated as ERUs.

Projects to reduce or avoid emission in developing nations would accrue CERs. The possibility of a developing nation initiating a CDM project for this purpose should not be excluded – in fact this could be a useful mechanism to get around the current impasse relating to additional commitments for developing nations. A percentage of CERs from all projects could go to the developing nation host for future use, to be banked, sold to the CDM Agency (See Section III below) or sold directly to a third party. The balance may be shared between the CDM Agency and private sector or government partners in developed nations. CERs may be purchased from the CDM Agency by developed nations at the prevailing rate for emission credits. In this way the CDM becomes economically driven and dependent on its success for future financing.

One of the stumbling blocks under the CDM to date has been the issue of adaptation projects and funds for such projects (Article 12.8). A specified percentage of CDM Agency income must be allocated to adaptation projects. It is argued that the viability of the CDM will be compromised if too high a percentage of funds are allocated to adaptation projects, and clearly this needs to be factored into the value attached to CERs. It may be necessary to establish a seed fund for initial adaptation project funding. In particular, projects that ensure food security, water availability, flood control, infrastructural integrity and robustness and primary energy flexibility should be implemented as a top priority.

Mechanism to Manage the CDM

A CDM Executive Board is to be established to co-ordinate and facilitate the mechanism. The composition of this Board is to be defined by the COP/MOP. It should, as a minimum, have equitable regional representation and demonstrate a balance between developed and developing nation membership. The Board would oversee the overall policy issues related to the CDM and operate as the primary liaison between the COP/MOP and the operational entities of the CDM. The latter would be established under the auspices of the Board. The Board would also oversee the allocation of funds to adaptation projects in underdeveloped and vulnerable countries. This centralised fund would be funded from the CERs generated by CDM projects (see illustrative examples below).

Here it is proposed that CDM Agencies be established to manage and facilitate CDM projects. The functions of these Agencies could be:

- Establishment of partnerships between CDM participants
- Measurement, monitoring and verification

- Reporting to the Board
- Handling of trades from Certified Emission Reductions to Emission Reduction Units
- Brokering and banking
- Identifying and funding adaptation projects in least developed and most vulnerable nations

A number of these Agencies could be formed, funding their own operations out of the proceeds of projects. However, initial seed funds should be provided – for example from the GEF. It would be desirable for CDM Agencies to be established in each developing nation, however regional agencies may be more appropriate. All agencies must operate under the auspices of the overarching CDM Executive Board to ensure consistency in policy application.

Once the CDM Executive Board and the CDM Agencies are established, their ongoing viability, and, as such, the viability of the CDM, will be determined by the business principles under which they operate. This will be driven largely by market forces – in particular the value attached to CERs and ERUs and the emission reduction targets set. The more ambitious the targets, the higher the value or CERs – especially long term ones - and the greater the probability of success of the CDM.

Given the strong role of business and market principles in this process, it is clear the private sector involvement in the CDM is critical to its success. In fact the main driver, once the policy framework and modus operandi have been established, should be the private sector.

The Adaption Fund

An Adaptation Fund will be established under the auspices of the CDM Executive Board. The purpose of this fund will be to finance adaptation projects in underdeveloped nations as well as those most vulnerable to the negative impacts of climate change. It is proposed that a list of such nations be established based upon their vulnerability assessments and their current economic situation. Resources in the fund would then be allocated to the poorest and most vulnerable on the list, in accordance with procedures to be established by the Board. The vulnerability assessments would also act as the primary source of information in identifying projects that enable those nations to adapt to the negative impacts of climate change. This concept is developed further in the Illustrative Examples below.

Principles to Apply to the CDM

A rigorous and well-defined process and policy framework must be established to manage the CDM. Clarification must be sought on eligible projects, banking, time frames, and the definition of a CER before any projects are established under the CDM. Steps must be taken to ensure equitable and balanced regional representation in the deliberations surrounding this process. In addition, the CDM should ensure an equitable regional spread of activities.

Emissions reductions projects already undertaken in developing countries under mechanisms such as AIJ should not be recognised as projects under the CDM, unless first subject to a rigorous assessment as to their sustainability and eligibility as CDM projects.

CERs must be verifiable by credible, independent assessment in the spirit of transparency and openness. The criteria to be used for verification must be defined by SBSTA. It is recommended that the IPCC be requested to prepare a technical proposal in this regard.

The same standards should be applied to the CDM as to emissions trading and JI with respect to:

- Units of measure (tons of CO_2 equivalent)
- Verification and certification of reductions
- Global equity
- The total percentage of all three mechanisms that may be used to offset emission reduction targets. The principle of requiring the majority of reductions to be undertaken in the home country should be applied in the short to medium term as the CDM develops, however this provision should not apply in the long term.
- Assurance of sustainability and non exploitation, especially of developing nations

The CDM is a complex mechanism that has huge potential to not only address climate change and facilitate sustainable development, but also to create a framework that aligns market forces with sustainable development. It could however be compromised in its early years if it is poorly planned and implemented. As such a planning and pilot phase is proposed. This phase must be better set up than AIJ, in order to ensure comprehensive testing and global buy-in – especially by the poorest and most vulnerable nations. The pilot phase should test a variety of principles using projects such as those illustrated below.

Illustrative Examples

Emission Reduction Example

An opportunity exists for a developing nation's coal fired power plants to improve their thermal efficiency from 20% to 30%. This opportunity may be identified by the developing nation themselves, a developed nation with emission reduction targets, a private sector player in either nation or by the local CDM Agency. A CDM feasibility study is then undertaken. This study would quantify the scope and longevity of the potential emission reductions, as well as determine the costs/resources required to undertake the project. In this case, assume that the potential is to reduce emissions by 50 million tons of CO_2 equivalent for the remaining life of the plants, which is 20 years, at a cost of US$50 million, i.e. US$1 per ton of CO_2 reduced.

Upon agreement that the project qualifies as a CDM project, the role players negotiate the allocation of Certified Emission Reductions. Guidelines for such allocations should be defined by the IPCC – but not mandated. A typical allocation could be 45% to the developing nation host, 50% to the developed nation host, 1% to the CDM Agency and 4% to the centralised adaptation fund. The latter would be for adaptation projects in the most vulnerable and least developed nations and is managed by the CDM Board but implemented by the local Agency (See example below).

The developed nation then funds the project to the sum of US$50 million and the reductions are certified by the CDM agency as being valid CERs with a lifetime of 20 years. An audit

mechanism will need to be established to verify the CERs and to avoid the CDM Agency inflating figures for its own advantage. The 50 million CERs are then allocated as follows:

25 million tons to the developed nation's private sector role player
0.5 million tons to the local CDM Agency
2 million tons to the Adaptation fund of the CDM Board
11.25 million tons to the developing nation's private sector role player
11.25 million tons to the developing nation government

The role players may then use their CERs as follows:

- The Developed Nation Private Sector Partner

The developed nation private sector player may immediately convert the CERs to emission reduction units that may then be offset against the emission reduction targets which have been set for it by domestic regulation. In this case the CERs expire after 20 years, so they need to be applied against time based targets within that period. Alternatively the firm may retain the CERs and sell these to other private sector companies that have their own emission reduction targets. The CERs would trade at the rate applicable to ERUs on the open market. In this example the partner has paid US$50 million for 25 million tons of CO_2 equivalent i.e. US$2.00 per ton. If the current market price of ERUs is above this then the partner makes a profit, if lower, a loss.

- The CDM Agency

The CDM Agency is obliged to sell its CERs to fund its activities. It may sell these to any buyer – end user or investor – at the current market price for ERUs and CERs. In this case the Agency will accrue the sum of 0.5 million tons times the prevailing rate for CERs.

Whilst the role of the Agencies in trading requires some clarification, it is not proposed that they run trading arms. It is rather proposed that existing commodity markets trade in CERs.

- The Adaptation Fund of the CDM Board

The Adaptation Fund may directly sell the CERs at the prevailing market price, or accrue them until it needs the cash resources to fund Adaptation Projects in underdeveloped and vulnerable nations.

- The Developing Nation Private Sector Partner

The private sector role player in the developing nation may directly sell the CERs at the prevailing market price, or retain them as an investment for future sale, obviously on the assumption that they would appreciate in value as a function of time. It will however have to accept the risk that, if innovative emission reduction technologies are developed, the CERs may reduce in value with time – as per any other commodity. This partner may also choose to retain the CERs for their long term application as ERUs in the event of that particular developing nation having its own emission reduction targets set sometime in the future. In this regard they will clearly have to consider the expiry date of the CERs.

The private sector partner may choose to co-fund the CDM project together with the developed nation partner in exchange for a greater share of the CERs. There is also nothing to prevent the private sector of developing nations from initiating and funding the entire emission reduction project. In this case they would accrue the majority of the CERs which may be retained as an investment or traded on international commodity markets.

- The Developing Nation Government

The CERs allocated to the developing nation government should ideally be applied to fund adaptation projects in that nation. This implies that they should be sold and the proceeds be applied to adaptation projects. The more likely scenario is however that the funds would be applied to the general budget and indirectly to reducing the vulnerability of the nation to climate change impacts. It is proposed that the allocation of funds not be mandated, but rather that nations be asked to account for how such funds were applied as a component of their national communications to the COP/MOP. It could be argued that the application of these funds to adaptation negates the need for the Adaptation Fund, however it is felt that the poorest nations will not benefit from the operational application of the CDM due to the limited potential for emission reduction in their nations. As such they require an additional source of adaptation funds.The above mentioned principles are also applicable to projects which avoid emission increases, for example a project to fund the incremental cost between a coal fired power station and a hydro power station.

Adaptation Example

Adaptation projects in developing nations would primarily be undertaken using a share of the proceeds from the CDM projects they host. These nations should define their own priorities in this area and allocate resources accordingly. They should be asked to account for progress in this regard as part of their national communication to the COP/MOP. It is recommended that vulnerability assessments in these nations be used to identify adaptation priorities.

In addition to the above, the Adaptation Fund should fund projects in underdeveloped nations and those most vulnerable to the negative impacts of climate change. In particular, such projects should be undertaken in small island states and African nations. The process to be applied here would be for the CDM Board to work together with the Governments of these nations in developing a strategic adaptation programme for that nation. This would comprise a prioritised list of projects that would be funded both from the local proceeds of CDM projects as well as the Adaptation Fund. Examples could include water provision programmes, food security programmes, and flood management systems. The projects would need to be undertaken in co-operation with the developing nation government and the local private sector. If the local private sector does not have the capacity to undertake the project then the initial phase of the project should focus on the development of such local capacity. In this way technology transfer can be effected and sustainable capacity can be developed in these nations.

Conclusion

The CDM is a new and exciting mechanism that has the potential to create an international platform for sustainable development. As outlined in this paper, the mechanism meets the needs of both the public and private sectors of both developed and developing nations, whilst meeting real development, adaptation and emission reduction objectives.

The Clean Development Mechanism as a Tool for Enhancing Substainable Development

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Introduction

This paper examines how CDM can contribute to the attainment of sustainable development in an African context. It briefly defines this concept and suggests criteria and indicators for its assessment. The paper then outlines Zambia's greenhouse gas emissions scenario and areas where CDM projects could potentially contribute to sustainable development.

The Clean Development Mechanism (CDM)

The Kyoto Protocol (Article 12(2)) states: "The purpose of the Clean Development Mechanism shall be to assist parties not included in Annex I in achieving sustainable development and contributing to the ultimate objective of the convention, and to assist parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3"

Although the operational details of CDM are in the process of formulation and discussion, it has generated mixed feelings in both developed and developing countries. It is generally agreed that CDM can be a means of assuring that the interests of Parties from both industrialised and developing countries are met. Most developed countries, however, view CDM merely as a cost efficient way of mitigating global greenhouse gas emissions through creation and sharing of credits from emission reductions in developing countries. Crucial issues that will occupy discussions regarding the creation and distribution of credits include their tradability (Michealowa et al 1998) and whether or not they can be banked.

On the other hand, developing countries such as Africa hope that CDM can contribute to sustained economic growth, poverty eradication, technological transfer and capacity building. Thus

- CDM should address sustainable development and technology transfer
- There should be equity in terms of benefits and access to CDM
- Governance issues should be addressed, particularly the structure and design of CDM
- Operational and methodological issues (including certification and verification criteria for CDM projects) should be addressed
- As a funding mechanism, CDM should not replace Official Development Assistance (ODA)
- There should be increased support for capacity building in Climate Change issues.
- Issues of transparency and accountability should be addressed.

This paper emphasises that Africa must seek to highlight the sustainable development aspect of CDM.

Substainable Development and its Assessment

Broadly, sustainable development can be defined as attainment of economic growth and e-quity given environmental constraints. For sustainable development to have a meaningful impact, it is essential that projects and programmes designed under CDM are assessed based on the following criteria:

- Financial sustainability
- Economic Sustainability
- Environmental sustainability
- Technological sustainability
- Social sustainability

Financial Sustainability

If private sector participation is to be encouraged in CDM projects and programmes, it is es-sential to attain financial sustainability. This can be determined via the usual indicators:

- Profit and loss
- Balance sheet
- Cash flow requirements
- Financial indicators
  - Internal Rate of Return (IRR)
  - Net Present Value (NPV)
  - Pay back Period

Economic Sustainability

Implementation of CDM projects and programmes may facilitate the realisation of sustainable socio-economic growth. Since energy is a major means of production and also a strategic input, its availability should not be limited by factors beyond a country's control. Therefore, CDM projects and programmes should strive to select energy supply alternatives that are based on the use of locally available domestic sources.

Meeting energy sector requirements is particularly a problem in most developing countries, where the lack of capacity to finance investments is a major factor limiting growth. One important factor is how capital resources for energy investment are allocated vis-a-vis other sectors such as health, education and infrastructure development. In most cases, the smaller scale, clean and innovative energy supply and efficiency investments needed under sustainable development strategies are marginalised in preference to other sectors. As developing countries, therefore, it is essential that the proportion of public energy investment is related to the level of GDP. The key issue under economic sustainability is the need to lower the burden created by energy investments.

Environmental Sustainability

Two aspects are considered here, namely global and local environmental analysis and assessment. Global environmental impacts should be measured by the amount of greenhouse gas emissions avoided under baseline and mitigation scenarios including the cost of reduction of each option. Local environmental impacts should be assessed using measurements of the most significant local pollutant.

Technology Sustainability

Energy productivity is the inverse of energy intensity and is measured by GDP divided by primary energy consumption. It should increase when a country is able to produce as many or more goods with less energy. On the other hand, sustainable energy deployment can be measured by the share of energy output derived from energy conservation and renewable sources (excluding mega-hydro energy and unsustainable biomass exploitation).

Social Sustainability

The implications of CDM projects on social sustainability can be measured by:

- The percentage of the rural and peri-urban population with access to power supply
- The percentage of energy expenditures in the overall household budget (affordability)

- Employment creation, measured by the number of in-country direct jobs created by an energy initiative compared to overall job creation (poverty eradication)
- Benefits accruing to gender equality through measurement of reduction of time needed for fuelwood gathering, the reduced burden of carrying water and through provision of decentralised electricity for lighting.

Zambia's Greenhouse Gas Emissions and Sinks Scenario and Projections

The choice of CDM projects should really be based on a country's greenhouse gas emissions and sinks scenario and projections under baseline conditions.

In the case of Zambia, emissions from energy, industrial processes, land-use change and forestry, and sinks are shown in Table 1.

Table 1. CO_2 emissions from energy, industrial processes, land-use change and forestry (tonnes) (Yamba et al 1998)

	1995	**2010**	**2030**
Energy	2,133,190	4,190,550	10,502,190
Industrial Process	297,636	695,825	1,524,557
Land-use activities			
• On site burning	53,829,590	94,624,370	200,792,360
• Off site burning from other sector	14,892,140	20,013,800	36,147,150
• On site biomass decay	5,486,940	8,501,110	15,954,500
Sub Total	74,208,670	123,139,280	252,894,000
Total	76,639,496	128,025,655	264,920,757

Table 2 shows the final budget for emissions and sinks for the year 1995 and projections for 2010 and 2030

Table 2. Projected GHG Budget

Source	1995	2010	2030
Emission	76,639,496	128,025,655	264,920,757
Sinks	74,087,480	126,888,750	262,240,530
Balance	-2,552,016	-1,136,905	-2,680,227

From Table 1, it is evident that energy use in Zambia contributed 2.1 million tonnes of CO_2 to the atmosphere, with projections amounting to 4.2 million and 10.5 million tonnes for the years 2010 and 2030 respectively. The largest relative contributions came from mining (43%), transport (32.0%), and Industry (16%). CO_2 from industrial processes (mainly cement and lime production) amounted to 297,636 tonnes in 1995 and 696,825 and 1,524,557 tonnes for the years 2010 and 2030 respectively.

However, the largest contribution of CO_2 emissions came from land-use change and forestry, mainly on site burning (arising from shifting cultivation, permanent cultivation and charcoal production), off site burning of forest biomass (in the form of charcoal and firewood combustion for cooking purposes), and from forest biomass decay. The regeneration of natural forests following forest clearing and/or abandonment of managed cultivated land (fallow) and reforestation plantations are the major carbon sinks in Zambia (Yamba et al 1996). The projections for the sinks are based on forest land clearing for shifting and permanent agriculture, charcoal production, commercial firewood and timber harvesting.

Potential Projects for Consideration under CDM

Results from Zambia's greenhouse gas emissions and sinks scenario and projections indicate that Zambia's net emissions are close to zero. It is clear from the results that CO_2 arises predominantly from land use change and forestry activities, followed by energy and industrial processes. Therefore, measures for mitigation should be targeted towards these areas. it is also essential that the measures adopted should be in conformity with the country's development objectives.

Some of the measures which can go a long way to achieving both Zambia's development objectives, and global environmental concerns include:

- Forest management
- Household energy use
- Ethanol and cogeneration from sugar cane resources

Forest Management

As indicated earlier, Zambia is almost in a net emitter of GHGs. This is due to the high rate of population growth (3.5%) which in turn has exerted pressure on forest resources, which are the major sink for greenhouse gases. Secondly, the agricultural sector in Zambia is dependent on extensive production systems, such as shifting cultivation. A combination of these factors will increase the conversion of forests to other forms of land-use. In turn, this will reduce the capacity of forests to act as sinks for greenhouse gases.

Among the many mitigation options that have been considered, improved management of indigenous forests presents the cheapest and most sustainable approach to increasing the forest cover. However, because indigenous forests grow relatively slowly, there is an urgent need to embark upon mitigation measures.

Before a full-scale country-wide programme on improved and sustainable forest management is implemented, it is essential that an assessment and evaluation is made to determine its effectiveness as an option for mitigating climate change.

A proposal aimed at evaluating such forest management projects in selected areas of the country and monitoring their effectiveness with respect to climate change mitigation is currently being recommended. The main objective of the proposal is to establish a number of forest fields in selected areas with local community support using a set of management techniques designed to enhance forest growth and sustainable utilisation.

Data on forest health and structure will be collected periodically and analysed to establish gains in greenhouse gas sequestration, projecting the long term effects of the forest sector mitigation option. The specific objectives include the following:

- To determine the extent of net emissions/sinks in selected areas in Zambia
- To introduce mitigation options in forest management, including charcoal production
- To monitor deforestation and forest regeneration effects in selected areas

These objectives will be achieved by describing the baseline development path, and emissions and sinks. The project will last for several years in order to generate sufficient data for model development.

Household Energy

As shown earlier, considerable amounts of CO_2 are emitted through offsite burning, especially combustion of firewood and charcoal as household energy. For example in the year 1995, an estimated 15.0 million tonnes of CO_2 were emitted from this source.

Mitigation measures that have been considered in the household sector include energy substitution and efficiency of cooking appliances. Three specific mitigation options have been identified, and these are

- Increased use of electric stoves.
- Introduction of improved charcoal stoves
- Use of coal briquettes produced from coal slurry from a local mine.

Table 3 shows the market share of cooking stoves for 1995, 2020 and 2030.

Table 3. Market share of cooking stoves for 1995, 2010 and 2030

Area	**1995**			**2010**		**2030**	
	Stove	Number	%	Number	%	Number	%
	Electric	130,732	9	500,000	22	1,300,000	31
	Imp. Charcoal	0	-	250,000	11	410,000	10
URBAN	Coal Briquette	0	-	100,000	4	150,000	4
	Charcoal	388,785	27	201,368	9	262,554	5
	Firewood	34,559	2	17,808	1	19,124	1
	Kerosene	8,640	1	8,904	1	9,562	1
	Electric	0	0	0	-	0	-
	Charcoal	68,208	5	116,792	5	198,576	5
RURAL	Firewood	784,392	56	1,051,298	47	1,787,184	43
	Kerosene	0	0	0		0	-
Grand Total		1,415,316	100	2,246,000	100	4,137,000	100

Source: Yamba et al 1998

Implementation of such options will go a long way in contributing towards the reduction of CO_2 emissions and enhancement of sinks. The amount of CO_2 reduced through these measures is given in Table 4.

Table 4. CO_2 reduction and associated reduction costs under household energy options

Option	Cost of reduction US $/ton CO_2	*Emission Reduction million tonnes* 2010	2030
1. Electric Stove	-10.55	2.54	4.81
2. Use of improved Stoves	-29.11	0.55	0.76
3. Use of Coal briquette	-11.97	0.04	0.06
Total		3.13	5.63

Source: Yamba et al 1998

To implement such projects in the household energy sector requires the establishment of a medium sized manufacturing facility with modest and modern equipment and machinery for

manufacture of improved charcoal, two plate electric and coal briquette stoves. In addition, production of coal briquettes will require a coal briquetting plant with an estimated capacity of 100,000 tonnes per annum. On the energy supply side, ZESCO's programme to provide electricity to an additional 20,000 houses per annum over the next 10 years, should continue and be supported.

Sugar Cane Resources for Sustainable Development

Traditionally, sugar cane industries in Africa and other parts of the world have been associated with production of sugar for human consumption and industrial use. In most cases other by-products like ethanol and electricity were treated as insignificant secondary products.

In the recent past, however, it has been realised that sugar cane can contribute to the attainment of sustainable development through flexible optimum production strategies. With advanced techniques and technologies, sugar cane can be used to produce raw sugar, ethanol, molasses and electricity.

Ethanol from sugar cane can be made and blended with gasoline (up to a ratio of 15%) for use in existing motor vehicles without major modifications. Such a use would reduce both greenhouse gas and harmful emissions while stimulating development of a locally available resource. For example, in 1995, CO_2 emissions from the transport sector amounted to 858,600 tonnes, or 40% of the total emissions from the energy sector (Yamba et al 1998). Introduction of ethanol will lead to a reduction of 70,000 tonnes of CO_2 per annum in the year 2010, rising to 120,000 tonnes in the year 2030 (Yamba et al 1998).

Bagasse, a by product of sugar cane processing, is used directly in boilers to produce steam for electricity generation. In view of the availability of advanced combined heat and power technologies (co-generation), bagasse can now be economically used to produce more electricity than the sugar refineries need. The surplus electricity produced can be sold to national grids.

In conjunction with the Stockholm Environment Institute, and with support from the Swedish Development Agency (SIDA) and the Government of the Republic of Zambia, the Centre for Energy, Environment and Engineering (CEEEZ) is currently undertaking a study aimed at developing alternative uses of the sugar cane resource in Luena in Northern Zambia. It hopes to identify investment alternatives that are most advantageous for sustainable development. The study will develop and compare different scenarios for production of electricity and the sale and consumption of sugar, ethanol, and other related products and services.

Qualitative Assessment of Potential Projects for Substainable Development

An attempt has been made to qualitatively assess the three identified projects in matrix form as shown in Table 5.

Table 5. Qualitative Assessment of the sustainable development benefits of identified projects.

Project	**Financial Sustainability**		**Economic Sustainability**		**Environmental Sustainability**		**Technological Sustainability**		**Social Sustainability**	
	General	Indicators	General	Indicators	General	Indicators	General	Indicators	General	Indicators
FOREST MANAGEMENT	N	N	HIGH	- More forest resources created	HIGH	- Deforestation avoided= - CO2 avoided= - Sink created=				
HOUSEHOLD ENERGY 1. Electric Stove	M	IRR= NPV= PAYBACK PERIOD=	HIGH	- Improved capacity utilisation of utility	HIGH	- Deforestation avoided= - CO2 avoided= - Sink created=	H		H	- Jobs created - No. of houses electrified increases
2. Improved Stove	M	IRR= NPV= PAYBACK PERIOD=	M		M	- Deforestation avoided= - CO2 avoided= - Sink created=	M		M	- Jobs created
3. Coal Briquette	M	IRR= NPV= PAYBACK PERIOD=	M		M	- Deforestation= - CO2 avoided= - Sink created=	M		M	- Jobs created
SUGAR CANE	H	IRR= NPV= PAYBACK PERIOD=	HIGH	- Foreign exchange savings - Delayed energy investment - Exports	H	- CO2 avoided=	H		H	- Jobs created - Improved electricity supply - Increased standard of living

General Classification

L - Low electricity
M -Medium Electricity
H - High
N - None

Improved electricity accessibility

Conclusions

An attempt has been made to quantify how CDM can contribute to attainment of sustainable development in Africa. Sustainable development has been briefly defined, and means proposed for its assessment. On the basis of Zambia's greenhouse gas inventory, several potential projects have been proposed as CDM candidates. An attempt has also been made to qualitatively assess the three identified projects in terms of their sustainable development benefits.

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The Clean Development Mechanism: Energy Projects for Africa

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Introduction

The Clean Development Mechanism

The Kyoto Protocol to the Framework Convention on Climate Change created a new possibility for North-South co-operation in mitigating climate change through joint projects. The Clean Development Mechanism (CDM), described in Article 12 of the Protocol, allows industrialised countries to purchase "certified emissions reductions" (CERs) from projects in developing countries which mitigate climate change. The CDM follows from the concept of Joint Implementation, where investors exchange capital and technology for emissions reductions from joint projects in developing countries. The significant difference is that the objective of the CDM, as stated in the Protocol, is to contribute to sustainable development and the overall objectives of the Convention, as well as assisting industrialised countries in meeting their emissions reduction targets.

The CDM provides an overarching accord for organising, structuring and financing initiatives which involve North-South collaboration with the objective of treating the global problem of climate change with mutual benefit to participating countries. If it is well constructed, the CDM will be able to focus on sustainable development in developing countries through an emphasis on avoided future emissions, while contributing to emission reductions in Annex I countries. To achieve such a role, the CDM would need to be clearly defined, and take into consideration the status quo of the collaborating Parties while not compromising the underlying principles of the UNFCCC. The CDM was defined only loosely in the Kyoto Protocol, and many questions as to how it would operate and what the role of developing countries will be are still to be answered. This paper highlights how the CDM could contribute to the African energy sector, and the issues that the energy sector raises for designing the CDM.

African Energy Priorities and Climate Change

The African Energy Sector

The African energy sector is a critical input to development on the continent, yet to date the sector has been plagued by problems which reflect the economic and environmental problems of many African countries: frequent power and fuel cut-offs, low access to 'modern' fuels and electricity, financially precarious energy sector institutions, and a chronic lack of infrastructure investment.

The lack of access to sufficient, affordable, and environmentally sustainable commercial energy is reflected by key energy indicators. Biomass continues to be the largest energy source, providing half of Sub-Saharan African energy. Per capita *commercial* energy use, among the lowest in the world, has actually been falling in recent years. Despite the low commercial energy use, energy intensity (expressed as energy use per unit GDP) is triple that of Europe, pointing to opportunities to significantly increase efficiency. Untapped commercial energy resources – hydropower, oil and gas - are significant, but concentrated in a few countries, necessitating better energy transport infrastructure (see below). In contrast, renewable energy sources, particularly solar, are abundant and well distributed, but major financial and other barriers to their use remain unresolved. Electricity generation is still limited outside of a few countries, with South Africa producing 52% of Africa's electricity. Total African generating capacity excluding South Africa is only one-twentieth of Europe.[5]

African Energy Sector Emissions

Given the small size of the commercial energy sector, it is not surprising that Africa's contribution to emissions of greenhouse gases is minimal. Total energy sector CO_2 emissions from Africa were only 3% of world emissions in 1990 (approximately 700 000 tons), even though Africa has 13% of the world's population. Sub-Saharan Africa, less South Africa, only accounted for 0.9% of world energy CO_2 emissions (WRI 1996). By contrast, the US commitment to a 7% reduction from 1990 levels under the Kyoto Protocol implies a reduction of 350 000 tons of CO_2, or half of Africa's total current emissions. Clearly, then, Africa's participation in the flexible mechanisms under the Kyoto Protocol must be based on avoided future emissions rather than current emissions.

Energy Priorities to Energy Projects

The CDM must bring together development priorities with emissions reductions. The starting point for thinking about CDM projects should be regional energy sector priorities. Building an energy sector that can fuel African development requires a range of approaches and strategies, which include the following:

- Structural energy sector reform to enhance performance, attract investment to the sector, and speed up the widening of access to commercial fuels, particularly electricity.
- Access to cleaner technologies for conventional fossil fuel systems.

5 Eskom 1996. Eskom Statistical yearbook. Eskom Corporate Communication, Johannesburg.

- Regional energy trade and interconnections.
- Greater range of technological choice, financing mechanisms and technology support for rural and decentralised energy systems.
- Sustained capacity building for policy analysis and implementation.
- Regional co-operation on standards, technology development, and policy.
- Improved forest management, cook stoves, and charcoal conversion methods to ensure sustainable and environmentally sound use of traditional fuels.

Energy sector projects to address greenhouse gas emissions, by contrast, tend to address a much narrower range of issues. Typical examples of energy sector GHG mitigation projects include the following:

Energy

- End-use efficiency improvements in household, industry and service sectors
- Transmission systems
- Fuel substitution
- Renewable technologies (decentralised)
- Supply technologies (centralised): fossil fuels, nuclear and renewable.

Transportation

- Efficiency improvements for vehicles
- Switch to fuel systems with lower emissions
- Improved transport system efficiency
- Modal shifts
- Managed transport demand.

In addition, biomass and traditional fuel accessibility are linked to afforestation projects, forest management projects, or reforestation, depending on how these projects are implemented.

The typical mitigation projects do not address many key areas for the African energy sector. For CDM to address the real issues in the African energy sector, therefore, the scope of CDM projects must be broader than conceived under Activities Implemented Jointly or Joint Implementation. One specific example, addressed in more detail in the section below, is the need for regional energy infrastructure. The point is that CDM projects must be more than technology development and project-level implementation efforts. The CDM will be most effective in reducing future energy sector emissions if it addresses the capacity, policy, financing, and technology issues that are critical to the development of a “sustainable” energy sector in Africa.

Regional Energy Infrastructure

In contrast to industrialised countries, throughout much of Africa liquid fuels for transport and electricity for all sectors are the largest portion of final demand. For electricity this is particularly problematic because capacity, and potential power development, is distributed unevenly. Regional electricity inter-connections are therefore one of the most important tools for improving access to commercial energy while reducing environmental impact. In Southern Africa, for example, greater sub-regional trade in electricity could substitute hydropower from Zambia, Mozambique and the Democratic Republic of Congo for dirty Southern coal-fired power stations, reducing both energy cost and related emissions. A 1993 SADC Energy project, for example, which focused on only five countries in the region, found that co-operation in power sector development could result in savings of more than 1.5 billion US$ over a period of 15 years (SADC 1993); and this is without including South Africa, which is by far the largest producer and consumer of electricity on the continent. Investments in transmission infrastructure and maintenance are a prerequisite for taking advantage of regional co-operation. In addition, strong co-ordinating centres, which can control supply switching, and ongoing capacity building in utilities and governments to manage a regional power system are necessary. Will the CDM be able to fund such efforts?

Sustainable Development

The successful implementation of any project or program is heavily dependent on how well it is designed. If the CDM is to achieve its aim of balancing Northern demands for GHG emissions reduction with Southern aspirations for sustainable development, its strategic design must include socio-economic and development indicators (Sokona et al. 1998).

The World Commission on Environment and Development defines sustainable development as meeting the needs of the present generation without compromising the ability of the future generations to meet their own needs. This is indeed a broad and general definition, which undoubtedly requires closer examination to be put into context.

One of the leading climate change NGOs in Africa, ENDA Tiers Monde in Senegal, points out that, if properly designed, CDM can make a decisive contribution to sustainable development in Africa, primarily through the implementation of desperately needed large-scale infrastructure development projects and programs. Professor Davidson of Sierra Leone argues that Africa has an opportunity therefore to link mitigation to development, and by doing so integrate environmental and developmental issues, increase natural capacity and negotiate the transfer of technical and financial resources.

A recent meeting sponsored by Climate Network Africa laid down potential areas and criteria for sustainable development contribution of CDM projects. These areas include:

- sustained economic growth
- poverty eradication
- social development
- meeting basic needs

- reduction or elimination of foreign debt
- real and meaningful technological transfer
- awareness and capacity building
- intra- and inter-generational equity (Climate Network Africa, 1998).

Since the key African concern with regard to the CDM is the contribution it can make to sustainable development, the main task is then to define what is included within sustainable development (or a process to define it) and develop tools to measure progress on a project or country basis. Measuring sustainable development is one of the most difficult areas for CDM projects, because there is not universal agreement on definitions or methods for measurement. A critical question is whether sustainable development must be defined across all CDM projects, or whether individual host countries should be responsible for their own definitions. The trade-off here is that, while individual countries should be setting their own priorities, individual governments do not necessarily choose projects which are the most beneficial to society in the long run for a variety of reasons. Whether it is possible or useful to impose standards is an open question.

On a national level, the United Nations Development Programme's Human Development Index provides one broad measure of development. Certain countries have also instituted measures of development or, more importantly, policies and plans to achieve economic and social development. How well CDM projects fit into those development plans could be one measure of their contribution to sustainable development. In the AIJ pilot phase, for example, it was generally the host country's decision whether the project fit their development priorities and they accepted or rejected the project on that basis. This re-emphasises the need for national baselines that reflect national policy priorities.

It is also important to draw in regional energy co-operation mechanisms with a clear view on how to incorporate sustainable development strategies. Regional regimes like ECOWAS and SADC can provide opportunities for CDM projects to address sustainable development issues more successfully, provided there is genuine co-operation and collaboration on issues of common interest. Regional co-operation on CDM projects has the potential to address many of the pressing energy poverty concerns experienced in African countries.

Institutions

Of the ninety-seven AIJ projects under consideration by the UNFCCC secretariat in 1998, 30% were in developing countries, mostly in Central America, with the remainder in the transitional economies of Eastern Europe (UNFCCC, 1998). Only one of these reported projects was in Africa. Why was Africa excluded from AIJ and what type of CDM and national institutions are required to ensure a regionally equitable distribution of projects?

Sokona et al (1998) argue that Africa was largely excluded from the AIJ pilot phase because of the focus of AIJ on emissions reductions, on the one hand, and because of the reliance largely on market forces, on the other. Africa contributes little currently to global emissions and, therefore, stands to benefit little from CDM if the focus is not expanded to include avoided future emissions. Furthermore, Africa's comparatively small and weak markets do not make it attractive to investors and, therefore, Africa will stand to be excluded from CDM, as was the

case in the AIJ pilot phase, if the emphasis remains purely on market forces. Finally, Africa is at a disadvantage in attracting both AIJ and CDM projects because it currently does not have the institutional and administrative infrastructure to develop climate change policy and proactively seek and implement projects.

Institutional Structure of the CDM

A key concern with regard to the construction of the CDM is how to create a mechanism which distributes funding and other benefits with a measure of equity not previously achieved under AIJ, while accommodating the development and energy priorities of the African continent.

The Kyoto Protocol alludes to the institutional structure of the CDM stating that it will be administered through three bodies:

- the COP/MOP, which provides authority and guidance;
- the Executive Board, a supervising body; and
- Operational entities to certify emissions reductions.

The roles of and linkages between these three bodies are currently being clarified. Observers to the Protocol have identified three possible roles for the Executive Board (see Sokona, et al 1998):

1. *A certification body for projects involving transfer of emissions reductions*: The Board acts as a regulatory body only, ensuring transparency and standards of application and crediting.
2. *A project clearing house*: The Board will act as a contact point, bringing together private or public actors with projects and programmes to implement and those with the means to implement them.
3. *A project co-ordinating body and funding agency*: The Board acts as a broker, actively seeking and accumulating funds and actively eliciting projects and programmes. The CDM would define criteria for the acceptance of projects and the allocation of funds, which meet the objectives of both emissions reduction and sustainable development and ensure an equitable distribution of activities and finances on a geographical basis.

In scenario one, the CDM Executive Board is little more than an AIJ certification body. Projects would be developed and implemented bilaterally, prejudicing against investment in the large-scale and regional-based infrastructure projects (such as energy supply, transport and communications) which are required to stimulate markets and facilitate sustainable development in Africa. Emissions reductions are likely to be emphasised over and above sustainable development, and equity considerations are unlikely to be addressed.

Scenarios two and three both allow the CDM to function in a multilateral fashion. Scenario three, however, expands the role of the CDM Executive Board to one that is more visionary and proactive. As a co-ordinating and funding body, the Board could set criteria and apply standards to ensure geographical equity considerations are taken into account, ensure that the CDM dual objectives of emission avoidance and sustainable development are given equal

weight, and that funding is available for projects initiated by host countries (Sokonaet al 1998). The obvious disadvantage of this approach is that a relatively large bureaucracy would be needed within the CDM to carry out all of these functions and monitor them. This could delay projects and reduce the total number of projects. On the other hand, it might mean that only those projects that truly meet both goals of the CDM were implemented, rather than those focused mainly on emissions.

National Institutions

One of the biggest barriers to the successful implementation of CDM in Africa is that the institutional capacity and organisational and administrative infrastructure required to develop and implement climate change policy is largely absent. Without strong and well-linked institutional structures, it is difficult for African countries to develop a strategic vision with regard to their involvement in the international climate change arena and more specifically, the CDM. The constraints on framing or shaping their involvement in the CDM creates difficulties for Africa in ensuring that their developmental needs and energy priorities are given sufficient weight. Furthermore, this lack of institutional capacity raises the transaction costs and risks associated with conducting CDM projects in Africa. The creation and maintenance of strong institutions and efficient structural linkages between these institutions is thus essential for the implementation of the CDM in Africa (Sokona et al 1998).

Analysis of the AIJ pilot phase provides some insight into the structure and roles of the institutions required to develop and implement climate change policy and the CDM in particular. Most countries that have established AIJ/JI programmes have a central co-ordinating office. In some industrialised countries, for example the USA, these programmes have sizeable central staffs devoted to a whole range of functions. In most developing countries, however, the climate change co-ordinator has limited capacity and is restricted to an informational role (Hirst & Fecher 1998). An exception is Costa Rica, one of the most proactive developing countries with regard brokering AIJ projects, where the government has made a significant effort to set up a JI office and integrate climate change into its national policies and institutions. There are clear advantages to having a strong centralised co-ordinating institution which can:

- develop national climate change policy and define national CDM goals within the context of other national and regional policy processes
- integrate CDM policy with other environmental, economic and social policy
- formulate national CDM negotiating positions and contribute to regional and international debate
- develop CDM procedures, criteria and guidelines for approval
- engage in proactive project identification; and
- disseminate information.

To integrate CDM policy with other national and international policies, inter-departmental co-ordination must be fostered at the national government level. The USA, Mexico and the Netherlands have interdepartmental steering committees for JI to assist with co-ordinating AIJ and climate change policy with economic, natural resource and energy policy and to get input from these sectors (Hirst & Fecher, 1998). The development and implementation of energy-

based CDM projects will require co-ordination between the environment, energy and trade/industry sectors of government.

Linkages to Stakeholders

To ensure the effective implementation and long-term sustainability of energy sector CDM projects, it is vitally important that affected and involved stakeholders are identified, consulted and invited to participate in the design and ongoing management of the project. Many technology transfer projects in Africa have not sufficiently involved local stakeholders and have thus failed to adequately define the needs, skills, training and financial requirements for sustainable intervention. The following provide examples of some of the concerns of implementing specific CDM projects in Africa.

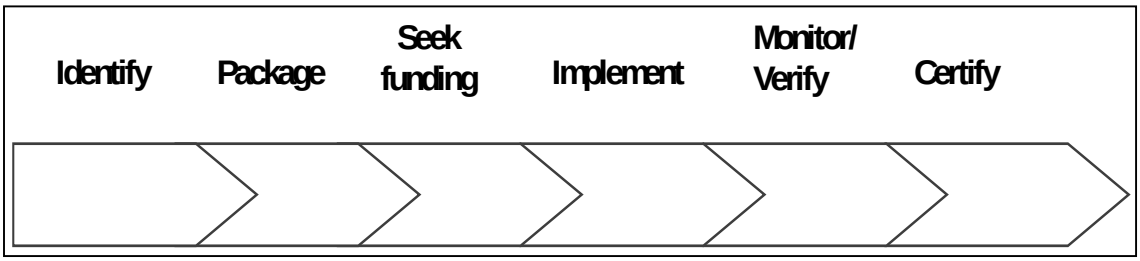
Forest management projects: Africa depends on biomass fuels and fossil fuels for most of its energy requirements, with the former accounting for over two-thirds of the total (Davidson et al 1995). While a number of forest management and preservation projects were implemented under the AIJ pilot phase, the Kyoto Protocol does not include sinks under Article 12 of the CDM. Much debate has occurred since Kyoto with regard to whether sinks should be included or excluded from the CDM. Concerns have been raised around the ability to guarantee forest sinks that are fuel resources for local communities. While it may appear that these are competing demands, local communities are reliant on the sustainability of wood fuel resources and through encouraging the active and effective participation of these communities in the design and ongoing management of forest projects, the sustainability of the project can be ensured.

Residential energy projects: The successful implementation of residential energy projects requires, among other things, an understanding of the energy consumption and behavioural patterns of the target households, the competing demands on household resources, and the informational, training and financial requirements for successful project implementation. Households in developing countries exhibit different energy use patterns to those in industrialised countries. CDM projects must avoid the pitfalls of past investment projects that have transposed northern models to southern countries, without fully understanding the local context. Research and development is required to ensure that the project is adapted to the local environment and meets the needs of affected or involved parties.

Fossil fuel sector: The mining and combustion of coal is a major contributor to CO_2 and methane (CH_4) emissions and presents an opportunity for substantial emissions reductions. While many have argued against clean coal technology as a mitigation strategy, the fossil fuel sector is a productive, labour intensive sector in Africa, providing employment for a large number of people. CDM projects which aim to address emissions from the fossil fuel sector must be sensitive to employment considerations, keeping labour informed and including their concerns in the design and implementation of the project. In keeping with the sustainable development objectives of the CDM, projects should be employment generating, rather than employment shedding.

Project Cycles

The project cycle will include a number of steps, as shown in Figure 1. At each step, clarity is needed on the role of the CDM institution and how this impacts the viability of projects and the overall goals of the CDM.



Identify and Package – As discussed in the section on institutional structures, the CDM can play a major role to address the inequities of the AIJ and JI initiatives by being proactive about identifying projects in under-served areas such as Africa. In addition, packaging many small initiatives into a larger umbrella programme, which can only be done by a more active CDM brokerage model, can reduce the transaction costs for investors and allow the CDM to address the large, regional energy infrastructure projects or capacity building efforts which contribute to more environmentally sound energy policies.

Funding – The project developers, national CDM programme, and an international CDM institution all play a role in seeking funding for CDM projects. Initiatives which promote linkages between project developers in developing countries and investors in Annex I countries are necessary to increase the opportunities for CDM projects. A CDM institution would also seek funding for projects in under-represented areas. This funding could come either from individual investors or from "carbon funds", which could bundle multiple investors into a single investment instrument.

Implementation – Almost all energy sector greenhouse gas mitigation projects will operate over a long period of time - typically 20 or more years. Implementation, monitoring, and certification are therefore ongoing processes, rather than finite tasks. Implementation must include not only initial technology transfers or injections of capital, but the sustained support for the projects, through training, maintenance, capacity building, and other measures. These ongoing needs, and responsibilities for them, must be clearly spelled out in the project proposal.

Monitoring and verification – Monitoring and verification will be the backbone of any successful CDM system. As models for how a certification regime could be implemented, two approaches are possible: a decentralised approach similar to professional accreditation, or a centralised approach similar to monitoring international weapons or election inspections. In the former, a central body would license individuals or firms to serve as accredited certification services, much the way certified accountants or lawyers have professional associations which accredit them. The advantages of this approach are: the central body does not have to be responsible or involved with every audit, and individual auditors have incentives to do their job effectively (so that they do not lose their license) and efficiently (so that they can afford to operate or make a profit if a private firm). The disadvantage is the risk of individual auditors "cheating" under pressure from project partners and not being picked up by the ac-

crediting authority. A centralised approach would be analogous to United Nations election inspectors or nuclear weapons inspectors, who are under direct control of the central body in each case. The advantage of this approach is that the centre has tight control over the outcome and process of each audit. The disadvantages are the potentially high costs of performing a large number of inspections around the world from one location, the costs of creating a new firm where capable organisations may already exist, and the lack of incentive to operate more efficiently.

Some private firms with experience in other areas of verification have already initiated plans to develop a greenhouse gas certification programme. NGOs are also involved with many of the current AIJ projects. Building on the skills available to develop an international network of qualified auditors under strict guidelines from the COP is likely to be the most cost-effective approach for certification and verification, particularly if the results of the audits are publicly available.

Certification – Article 12 of the Kyoto Protocol refers to "*certified* emission reductions" and *certified* project activities (para.6). Certified emission reductions (CERs) are essential components and provides the incentive for private sector involvement. While monitoring and verification will be necessary for all projects under flexible mechanisms, CDM projects would require certification from whatever institution governs the CDM. This certification is required for a transfer of emissions reductions under the Kyoto Protocol. Given that projects continue for many years, the timing of credit transfers has major implications. Ideally, credits would be certified and transferred *periodically*, rather than only at the beginning or end of a project. Transferring all credits at the beginning of the project obviously would increase the risk of non-compliance given all of the uncertainties with mitigation projects. Waiting until the end of the project would be too long for investors, who want to see a "Carbon return" on investment in the short to medium term.

Energy sector projects lend themselves to periodic certification and crediting, because introducing a new technology or implementing a large-scale initiative yields annual emissions reductions. Because the monitoring, verification, and certification processes all add cost to the project, it may be more cost effective to have certification and credit transfers every few years rather than annually. Implementation, monitoring, and certification should therefore be an iterative process, rather than a once-off transaction.

Conclusions

Much work remains to be done to clarify whether and how the Clean Development Mechanism can meet its dual goals of contributing to sustainable development in developing countries and assisting industrialised countries to meet their commitments to emissions reduction and limitation. This paper has raised a number of issues around the structure and operation of the CDM and its role in meeting the energy development needs of Africa.

Energy will play a key role in African development, and the CDM can contribute to sustainable development through investment in the energy sector if it focuses on African energy priorities, which are broader than one-off technology transfer and demonstration projects, and ad-

dresses large-scale regional initiatives, including capacity building or other activities not typical of GHG mitigation projects.

The CDM institution should, at a minimum, serve as a clearing house for projects and funding proposals, and a certifying body for CDM activities. To promote investment in regions such as Africa, however, a more systematic approach is necessary, which may involve the CDM serving as a broker or proactively seeking out projects. In this way the CDM can function as a multilateral funding body, channelling resources into regional energy and infrastructure projects which are necessary for sustainable development in Africa.

To ensure that Africa can effectively participate in the CDM, attention must be given to developing strong centralised institutional structures which can develop and implement national climate change policy; integrate CDM policy with other national and regional economic, social and environmental goals; negotiate positions in international forums and actively develop and initiate CDM programmes.

Stakeholders must be identified and invited to participate in the design of CDM projects to ensure that the emissions reduction or avoidance objectives of the project do not conflict with the developmental needs of affected and involved parties.

In the development of the project, there is a need for CDM to package projects and seek funding to lower transaction costs and reach under-served areas. Independent certification is critical to the credibility of the trading system; a network of accredited auditors under the authority of the COP is likely to be more cost effective than having all projects verified by the CDM Executive Board or a similar body. Periodic certification and crediting will reduce the risks associated with CDM projects. Energy projects lend themselves to such periodic certification.

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Designing Energy Projects in Africa for the Clean Development Mechanism

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Introduction

As the 21st Century approaches, the quest for climate change mitigation and sustainable development has become one of the most challenging tasks for humankind. Several international initiatives have been devoted to the development of effective strategies for sustainable energy in response to the climate change mitigation/sustainable development challenge. The UNDP and European Union recently commissioned a team of international experts to produce a strategic framework hinged around sustainable energy as a tool for development in African, Caribbean and Pacific countries. This paper will draw on some of the findings from this international endeavour.

The paper starts off with a discussion on CDM and sustainable energy objectives. The suggestion that the CDM should focus on large, regionally-based technical and organisational infrastructure development projects is highlighted and some specific projects are indicated. Various issues of relevance to project design for the purposes of the CDM are reviewed and the paper concludes with a call for a major effort at information dissemination among the key stakeholders in Africa, on newly emerging opportunities from climate-related financing mechanisms like AIJ and CDM.

Project Objectives

Article 12, Section 2, of the Kyoto Protocol states that

> *"The purpose of the Clean Development Mechanism shall be to assist Parties not included in Annex I in achieving sustainable development and in contributing to the ultimate objective of the Convention, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3."*

Sokona et. al. (1998) have argued that the CDM is not merely a mechanism for ensuring cost-efficient emissions reductions at the global level but more importantly for developing countries, it is a mechanism for ensuring sustainable development. Energy is one of the key components of sustainable development and the focus in this paper is on sustainable energy. In the particular case of Africa, an agenda for sustainable energy has been put forward recently as part of the UNDP/EU study mentioned earlier. This agenda embodies 12 objectives, which may be summarised as follows:

1. Accelerating Reform
2. Achieving Full Cost Recovery
3. Increasing Energy Efficiency/DSM
4. Increasing Renewable Energy Applications
5. Improving and Substituting for Traditional Biomass Fuels
6. Reducing Energy in Transport
7. Promoting Regional Cooperation and Trade
8. Placing More Emphasis on Productive Activities
9. Strengthening Institutional and Human Capacities
10. Paying Greater Attention to Women's Participation
11. Encouraging Broad-Based Policy Discussions; and
12. Increasing Local Financing and Private Sector Participation.

Some of the sustainable energy objectives listed above (3 – 6) may be directly associated with concrete projects and hence these objectives would be easier to link to GHG emissions reductions for the purposes of the CDM. Nevertheless, to the extent that the other objectives can be incorporated in potential CDM projects this will have to be done and these issues are explored further in subsequent sections of this paper.

Typical Projects

The CDM is essentially a mechanism for North-South co-operation in the quest for climate change mitigation and it is important that lessons from similar mechanisms be taken into account. One mechanism for North-South cooperation – Activities Implemented Jointly (AIJ)[6] – offers some learning opportunities for the CDM. Only one out of seventy-five AIJ pilot projects currently reported to the UNFCCC secretariat is being implemented in Africa. Some of the main reasons for this low participation are the emphasis placed by AIJ on emissions reductions on the one hand, and the lack of a strategic vision on the continent concerning the potential benefits of AIJ on the other hand (Sokona et. al., 1998). Other reasons put forward by Sokona et al. (1998) include Africa's comparatively weak markets which are not attractive to investors unless there is a longer-term incentive and the relative absence of the necessary administrative and technical infrastructures on the continent.

6 AIJ flows out Joint Implementation (JI); this refers to actions which reduce or sequester GHGs in one country with the collaboration of one or several other countries, who then receive "emission credits" in return. In the case of AIJ no credits are given.

CDM projects must address sustainable development priorities otherwise they will be largely irrelevant and uninteresting within the African context. Sokona et. al. (1998) have asserted rightly that, in Africa, it is necessary to think in terms of avoided future emissions rather than emission reductions. Thus, a marriage between the sustainable energy objectives outlined earlier in this paper and avoided future emissions becomes indispensable if CDM projects are to be taken seriously in Africa.

Sokona et. al. (1998) have suggested that, particularly for Africa, the CDM should focus on large, regionally-based technical and organisational infrastructure development projects. They argue that Africa's top priority as far as achieving sustainable development and avoiding potential future GHG emissions are concerned, is the development of regionally-based technical and organisational infrastructures. CDM could therefore act as a driving force for regional cooperation in Africa. The specific project examples mentioned in their paper include modern energy-efficient railway systems and regional power-sharing networks. Much as Sokona et. al. (1998) place the emphasis on regional infrastructural projects they also recognise the importance of national level projects such as major housing schemes which incorporate the use of energy-efficient devices. One should also include telecommunications networks within as well as across countries in view of their very large potential impacts on energy consumption and associated GHG emissions. Some specific examples of activities and projects at various stages of development, which could be considered as candidates for the CDM, are given below.

Gas Pipelines and Power Transmission Systems

A natural gas pipeline from Nigeria through Benin, Togo and Ghana to Côte d'Ivoire has been proposed. The pipeline would displace fuel oil use at thermal generation stations, with cost savings and local as well as global environmental benefits. West Africa's largest natural gas reservoirs by a wide margin are located in Nigeria where 75 % of all oil-associated natural gas is flared into the open skies. Several international schemes have been put forward to supply Ghana's CCGT plant with the million cubic metres of gas it would require per day at full load.

With respect to regional electric power systems, Ghana, Togo, Benin and Côte d'Ivoire are already inter-connected while Nigeria has a transmission line running to Niger. Extending the regional grid around Ghana and Côte d'Ivoire to include Burkina Faso, Mali, Niger and Nigeria would help to create a more competitive market, decrease vulnerability to drought, and increase the prospects for tapping additional hydro potential within these West African countries. Sahelian countries like Mali and Mauritania, which have small and relatively isolated national markets, stand to benefit greatly from increased cooperation with their neighbours. Regional electricity interconnections and trade, in particular, are essential for developing the hydro potentials in these countries, thereby increasing the availability of low-cost electricity supply as well as providing a source of export earnings. The scheduled operation of the Manantali hydroelectric plant in 2001 and Mali's connection to the Ivoirian grid will be important steps in this direction.

Decentralised Rural Energy Services

Sustainable energy in rural areas requires the active participation of the rural folk and well-defined rules of decentralised and often business-like management. Experience from Mali shows that when rural energy is coupled to productive activities the results can be far-reaching in terms of the drive towards sustainability. This finding arises from many small projects supported by UNIDO-IFAD in which multi-functional 8-10 hp motor platforms were developed to supply mechanical energy for productive purposes (shelling machines, oil presses, harvesters, etc.) as well as electricity for individual and community use (lighting, battery-charging and water-pumping). This linkage with productive activities helps to increase rural incomes, so that rural "motorization" has to be considered alongside rural electrification. The replication of such projects across Africa will be an essential part of the sustainable development agenda in the years ahead.

Bio-Energy for Cleaner Development

Various forms of bio-energy lend themselves to stimulating productive activities as well as improving environmental quality. In Mali, for instance, the production of bio-diesel from an indigenous plant is in progress; the bio-diesel is used in motors for mechanical energy and electricity generation in two villages. Further development and replication of this bio-diesel initiative throughout the region would be required.

The use of biogas and biomass residues for electricity generation in Ghana has also been proposed. In the case of biogas, a newly-formed private power company plans to apply the technology in human waste management systems across the country with electricity as a by-product; project proposals have been prepared and the company is actively seeking investment finance for this venture. Also, biomass residues from wood-processing industrial activities, particularly sawdust, have been causing an environmental nuisance for decades. A Ghanaian NGO is in the process of preparing proposals for using the wood-processing residues in co-generation facilities situated in or near the wood-processing firms and here too investment capital will be required.

Energy Efficiency/Demand-Side Management

The scope for energy efficiency improvements remains large in all sectors across Africa. In Côte d'Ivoire many building energy management schemes were implemented by the Bureau des Economies d'Energie (BEE). In Ghana, industrial energy audits and efficiency improvement measures like power factor correction have been implemented and the newly established Energy Foundation is pursuing several programmes to promote energy efficiency in the country. Nevertheless, there is a long way to go in the industrial and commercial sectors. The residential sector with its high peak load-shaving potential, has proved rather difficult to enter successfully, mainly because of the low purchasing power prevalent in the region. Higher efficiency lighting programmes will need to be thought through very carefully and implemented throughout the region. Progress made in the industrial and commercial sectors will also need to be furthered through projects that stimulate the market for Energy Service Companies (ESCOs) and provide opportunities for capacity building within the ESCOs.

Issues for Project Design

The activities and projects cited in the preceding section have been developed mostly by public-sector organisations and NGOs. Partly because of the weak markets across Africa and the relatively high transaction costs associated with sustainable energy projects, private sector involvement has been quite low. Mechanisms that bring together the various actors and reduce the entry barriers for private enterprises will therefore need to be actively promoted. In Ghana, the Energy Research Group (ERG) and the Ghana Solar Energy Society (GHASES) have played key roles in facilitating these linkages. Recently, for instance, the two organisations ran training workshops in solar PV technology for local entrepreneurs and technicians with financial support from the Energy Fund. Plans have now been developed to organise these workshops on a rolling basis throughout the country so that the knowledge gained through academic research and extension programmes may be passed on to entrepreneurs and technicians.

Network organisations like ERG and GHASES offer effective channels for linking as well as sharing knowledge among the various stakeholders (public and private), especially where government support is also forthcoming. In the development of CDM projects such linkages will have an important role to play. Apart from the absence of a strategic vision in many countries, as indicated by Sokona et. al. (1998), there is also a general lack of information concerning the newly emerging opportunities from climate-related financing mechanisms like AIJ and CDM. If the low level of African participation in AIJ is not to be repeated with CDM then a major effort at information dissemination among the key stakeholders will have to be embarked upon. Herein lies a challenge which NGOs are perhaps best placed to respond to. African NGOs interested in climate change issues could organise awareness raising programmes for public-sector personnel (including government officials) and private entrepreneurs. Targeting such awareness-raising programmes at multiple stakeholders should help to link them and provide nurturing grounds for CDM projects.

The point has been made over and over again that mobilisation and concerted effort on the part of all actors will be necessary if the aim of the Kyoto Protocol is to be achieved (Thomas, 1998). Thus, NGOs have an important role to play but this does not diminish the primary responsibility of public sector organisations, like the Environmental Protection Agencies in many countries, to undertake similar awareness-raising programmes on newly emerging opportunities from climate-related financing mechanisms. Specific organisations in the different countries will need to be targeted with due regard to their critical roles in the project development process. Private enterprise associations and national investment centres are some of these specific organisations. Financial sector institutions (i.e. development banks, venture capital funds) and associations of consulting firms (particularly those that include management consultants) will also need to be made fully aware of the new climate-related financing mechanisms.

Conclusions

This paper has introduced a 12- point agenda for sustainable energy including objectives that may be directly associated with concrete projects and hence easier to link to GHG emissions reductions for the purposes of the CDM. A brief discussion of Africa's low level of participation in the pilot phase of the AIJ was presented and the need to learn lessons from this experience was underscored.

The suggestion by Sokona et. al. (1998) that, particularly for Africa, the CDM should focus on large, regionally-based technical and organisational infrastructure development projects has been highlighted. This suggestion helped to set the stage for the consideration of a range of projects for CDM financing. Some of the projects put forward for consideration are regional power-sharing networks, gas pipelines and energy-efficient railway systems. Other projects suggested as possible candidates for CDM financing are decentralised rural energy services which put more emphasis on productive activities requiring "motorization" and biodiesel production, as well as biomass residues and biogas plants for multi-purpose applications including environmental management. Energy efficiency/demand-side management was also suggested as an area where potential CDM projects may be developed.

This paper has pointed to the general lack of information concerning the newly emerging opportunities from climate-related financing mechanisms like AIJ and CDM as one of the problems requiring urgent attention if the low level of African participation in AIJ is not to be repeated with the CDM. In this regard, it was suggested that a major effort at information dissemination among the key stakeholders will have to be embarked upon, and this has been put forward as a challenge to African NGOs interested in climate change issues.

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Designing Projects/Programmes/Portfolios - Approaches for CDM

The Transport Sector in Africa

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Introduction

Development and the Transport sector

The importance of the Transport sector in development cannot be overemphasised. The Transport sector in Africa, as in other countries, is the engine of economic growth through its role in the movement of goods and passengers to national, regional and international markets. With the popular trend of countries forming economic blocks like the SADC and ECOWAS, transport is considered a means of regional integration, linking regional markets and the people.

The transport sector is one of the fastest growing sectors in terms of energy and infrastructure demand. Typically, road and rail transport are the major sub-sectors, with road transport alone responsible for about 72% of national energy consumption (Zhou, 1998). Approximately 80% of transport energy is in the form of petroleum products which, in the case of most Sub-Saharan countries except Nigeria, Gabon, Angola and Congo, are imported, contributing to the depletion of already scarce foreign earnings. Road and rail infrastructure building, together with the energy sector, make a significant contribution to the debt burden as a result of external loan financing provided by multilateral lending institutions like the IBRD of the World Bank and the African Development Bank. Fuel imports also impact negatively on the balance of payments.

Apart from being demanding in terms of infrastructure investment and fuel imports, the transport sector is far from efficient in terms of delivery of goods and services. For the sector to be a driving force for the much-needed economic growth in Africa, it must be able to adequately meet the needs of all transport consumers given economic constraints.

The major concerns in the transport sector in African countries are as follows:

- The road and rail network infrastructure is generally limited. Most road lengths are unpaved or are poorly maintained. Maintenance of existing infrastructure has been neglected, probably due to lack of capacity and financial resources. Revenue raised in the transport sector is not directed to maintaining infrastructure but is often channelled into sectors with immediate financial need and hence the roads in particular are poorly maintained.
- Railway lines are limited to specific routes with little flexibility in goods or passenger delivery. Railway systems in Africa are poorly managed and tend to operate below capacity. In general, the systems operate with run-down equipment, are unsafe for both freight and passenger delivery and also operate at a loss.
- The low per capita incomes in African countries have resulted in an old passenger car fleet. These old cars have high-energy intensity due to their poor fuel economy and outdated design. The number of such cars continues to increase as a result of policies in some African countries that encourage importation of second-hand vehicles. The old vintage of cars and LDVs, which are the dominant modal share in Africa, is significant in terms of energy consumption and both GHG and particulate emissions.
- The region has limited and unreliable mass transport facilities resulting in the prevalent use of private vehicles. With their low energy efficiency, the large fleet of private cars and LDVs contributes more GHG emissions per p-km or t-km transported than mass transit when used for the same purpose.
- Inadequate telecommunications facilities in Sub-Saharan Africa (generally less than 2 telephones per 100 people) imply greater reliance on motorised transport systems for communication, particularly in urban areas. The high frequency of travel also results in increased demand for transport energy, local and global emissions and road fatalities.

To reduce its transport sector energy demand and associated GHG emissions, Africa would therefore need to:

1. Improve transport energy efficiency through provision of adequate infrastructure (road, rail, telecommunications and mass transport systems).
2. Substitute current petroleum products with energy efficient and low emission fuels/energy sources.

Both these measures will also save on imported petroleum products and therefore help the balance of payments. In addition, other environmental problems like air pollution, traffic congestion and accidents, which are increasing concerns across Africa, will be alleviated. The necessary skills, institutional participation, legal framework and, more importantly, financial resources are also paramount in ensuring the success of the process.

It is envisaged that under the global effort to limit greenhouse gas (GHG) emissions, African countries can obtain technological and financial resources to improve efficiency in their transport sectors. In the recent past the Global Environmental Facility (GEF) and Activities Implemented Jointly (AIJ) have been the sources of UNFCCC financing of GHG reduction activities. The application of these financing modalities in the transport sector has not occurred in Africa. One well-publicised AIJ project in transport was the Urban Transportation project on Fuel Cells in Hungary, financed by the government of The Netherlands. The reason why Africa did not actively participate in past UNFCCC-financed activities could be due to the reactive approach taken by the continent or to the lack of skills for identification and packaging of acceptable projects.

The Clean Development Mechanism (CDM), defined in the Kyoto Protocol, is yet another financing mechanism from which developing countries, African countries included, could benefit from technological and financial resource flows. In a situation where Annex I countries are bound by the Protocol to make significant (5-8%) reductions in their GHG emissions by 2008-2012, their large companies, including those in the transport sector, may start looking at reducing GHG emissions in Africa as a means of meeting regulatory targets. The notion that Northern companies may invest in GHG reduction projects in the developing world is premised on potential cost savings. The South then assumes that new technologies will be transferred in the process.

Climate Change and the Transport sector

In 1990, the transport sector, which includes passenger travel and freight movements by road, rail, air and water, was responsible for 25% of the world's primary energy consumption and 22% of the GHG emissions from fossil fuels (IPCC, 1996). The transport sector is second only to the power sector as an emitter of fossil fuel based-GHG emissions. In Africa, where the industrial base is small, the transport sector might even dominate GHG emissions, as the power sector is not very well developed outside the oil and coal producing countries. The transport sector continues to grow rapidly in response to rapid population and urbanisation growth rates. It is responsible for large emissions of gases like N_2O and NOx, which have significant Global Warming Potentials and can therefore strongly influence climate change.

Calculating the true cost of developing the transport sector to meet demand in Africa at a time when the environmental impact of releasing GHGs into the atmosphere is added to the equation is a contentious issue. The question as to who is to pay for the GHG reduction is also critical. Although Africa, as a developing region, can obtain assistance from the GEF and the Clean Development Mechanism (CDM), it still has to learn to access these resources.

Modalities of the CDM Applied to the Transport Sector

Past experiences with GEF and AIJ have already demonstrated that when projects are well packaged, they can qualify for financing under UNFCCC modalities. It is therefore crucial for African countries to have a clear understanding of how they can benefit from the CDM and how project activities can be framed to benefit sectors such as transport.

As Article 12 of the Kyoto Protocol stipulates: *the CDM shall assist in arranging funding of certified project activities*- projects resulting in certified emission reductions. The requirement is therefore to be able to define project activities, in this case in the transport sector, which can meet the certification process and will show GHG emission reductions above the agreed baseline.

It is well acknowledged that setting an appropriate baseline is a difficult task, and the task is even harder when dealing with the transport sector. It is therefore imperative to refine procedures for defining the sector baseline and calculating potential GHG reductions from the various available options. For the majority of transport sector options, the quantitative emission

effects cannot be evaluated and yet this quantification aspect promises to be critical in the certification of CDM projects.

One crucial shortcoming with emission projections in the transport sector is the dependence on travel forecasting models that have large uncertainties due to paucity of data. This means that whatever GHG emissions are estimated for the baseline and mitigation scenarios may not be as accurate as those estimated for options in other sectors. The difficulty may be avoided by choosing projects that can be translated into bulk replacement of known petroleum demand by low GHG emission fuels or energy sources. Projects could also involve corridor transport studies where monitoring of traffic is possible and modal shares can be estimated, thereby allowing projection of transport services demand, and the associated GHG emissions avoided when improvements are made to the corridor systems.

The developmental approach (IIEC, 1995) whereby transport project activities are implemented as part of an integrated transport planning process, will only yield potential magnitudes of GHG emission savings, and this will probably not be accurate enough for the CDM. A further problem is that the emission factors for the various transport modes and their operating conditions are not widely uniform and this is an area that requires further research.

Potential Climate Change Mitigation Projects-Transport Sector

The transport activities discussed below are intended to indicate the potential for greenhouse gas emission reductions in the transport sector and point to directions for CDM financing.

Transportation Mitigation Options for African Countries

The kinds of options for mitigating global climate change in the transport sector range from technological (e.g. fuel substitution), through to the policy-orientated (e.g., imposition of duties) and on to the behavioural (e.g. education about driving practices). The emphasis for CDM projects may be on the technological options that would also help solve many of the problems crippling Africa's transport sector, as discussed in earlier sections of this paper.

a) Substituting imported and polluting petroleum products with locally derived energy sources like electricity and regionally available fuels such as natural gas- based fuels. Fuel substitution can in theory eliminate all transport GHG emissions in the case where hydroelectricity and sustainably produced biomass-based fuels (like ethanol and menthol) can be used in all transport modes. These options may be possible in those African countries where hydrological flows are 'healthy' and rainfall can still support large biomass plantations. Natural gas-based fuels, like CNG and LNG, can also drastically reduce GHG emissions in the transport sector. Large reserves of natural gas have been discovered in recent years in many African countries. What is limiting the widespread use of these fuels is the lack of exploitation and delivery systems whereby the gas can reach potential consumers in the transport, power and industrial sectors. Some retrofitting to end-use devices may also be necessary in order to shift to zero or low emission energy sources.

b) *Replacing the old fleets of cars and LDVs and improving mass transit systems.* The IPCC Second Assessment Report estimates a potential reduction of primary energy use of 30-70% by travel mode switching from car to bus or rail. Both transboundary corridor and metropolitan mass transit systems would result in improved access to transport services, increased mobility, improved air quality and reduction of GHG emissions. Intra-urban, inter-urban and regional corridor routes could be considered for both freight and passenger mass transportation. The necessary incentives and fiscal measures ought to be in place to encourage consumers to shift to mass transit systems.

c) *Building up-to-date road and rail infrastructure networks along strategic routes.* This will also result in the regular flow of traffic, efficient delivery of services, energy savings and hence GHG emissions reduction

d) *Using indirect infrastructure like telecommunications and pipelines to displace motorised transport.* These options could also be considered for CDM financing, but the effect of telecommunications use on energy demand may not be easy to determine. Substitution of petroleum road and rail freight by a pipeline can be an attractive CDM infrastructure project as the petroleum demand is easy to calculate and the displaced motorised freight transport can also be determined with reasonable accuracy.

Financing

Apart from current financing from multilateral lending agencies like the World Bank (IBRD, IFC) and the African Development bank, and Official Development Assistance, a number of private sector financing options are now emerging for the construction of transport infrastructure. These include Build Operate and Transfer (BOT) or Build Operate Own and Transfer (BOOT) for new infrastructure, and Finance, Rehabilitate, Operate and Maintain (FROM) for rehabilitation of substandard transport infrastructure. These sources of finance can continue to be used on a discretional basis but in a situation where the proposed transport project activities can result in sizeable GHG reductions. The projects could be marketed to transport companies from the North, who, in addition to creating a business opportunity, can also accrue GHG reduction credits under CDM.

The incremental cost budget under GEF programmes is too small to build any significant transport infrastructure, but GEF funding is available to remove barriers. This may involve awareness-raising programmes, especially with respect to energy saving measures and shifting to appropriate lifestyles, establishment of effective institutional structures for enforcement of regulatory and fiscal measures such as the introduction of a carbon tax, and capacity building to prepare countries to absorb new technologies in the transport sector.

Project Definition Under CDM

Criteria for CDM Operations

The key criterion should be that Annex I companies willing to invest in CDM projects should be restricted to investing in their current field of operation. This will almost guarantee that developed country transport companies will seriously consider investing in GHG reduction in the transport sector. AIJ suffered from too much flexibility in terms of where developed

countries could invest to reduce GHGs. These projects tended to focus on the forestry sector and did not yield the appropriate technologies that were anticipated at the outset of the AIJ process.

In principle, CDM would involve bilateral arrangements where the developed country transport company negotiates to invest in a developing country, probably in partnership with a local transport company. In bilateral dealings with the highly motivated, experienced and skilled private sector of the North, Africa's public-sector dominated investment institutions will be at a disadvantage. CDM's Executive Board can then play the role of ensuring that the project certification process does not prejudice the weaker negotiating Party. Making CDM a multilateral process with global project selection may result in delays in project implementation. Africa, with its weak project framing capacity, may lag behind other developing regions in creating acceptable and competitive CDM projects.

CDM transport projects should be above a certain agreed size of investment, beyond that which African countries can themselves afford. The projects should also be selected from among those with significant positive costs on the countries' GHG Abatement Cost Curves. Accepting only significant financial resource inflows will ensure that the large infrastructure projects required by the continent's transport sector can be realised without increasing the debt burden. New transport projects should be able to create efficient transport services and reduce GHG emissions, with the international community sharing a significant portion of the financial investment burden.

Africa has to guard against the developed countries replacing other forms of assistance such as ODA by CDM. The financial additionality concept, whereby CDM becomes an additional financing mechanism, should apply.

Institutional and Legal Framework

Projects qualifying for CDM have to be endorsed by the host country and hence institutions are required to direct the process. A legal framework is also required to ensure regulation of players in the projects and to determine how the benefits are to be distributed within the economy.

A concerted effort is required to gather the following resources if African countries are to realise potential financial and technological benefits from CDM.

a) Information centres for technologies, practices and management upgrading.
b) A common agreed set of criteria for accepting CDM projects so that the region has negotiation 'muscle'.
c) Direct involvement of Africa's expertise in all CDM projects to ensure technology absorption and the potential for upgrading such technologies in the future.

Sustainability Aspects

Aspects to incorporate in CDM transport projects in order to enhance sustainable development include:

a) Employment creation (directly or indirectly) and poverty alleviation.
b) Improved transport access and mobility
c) Elements which are 'precursors' for future technology improvement or allow technology 'leapfrogging'
d) Increased economic efficiency and market competitiveness
e) Debt relief and improvement in the balance of payments
f) Improved local air quality
g) Creation of infrastructure for long term use.

These are the development issues of interest to Africa and should carry as much weight in the assessment of CDM projects as the GHG reduction interest of Northern Parties.

Capacity Building Aspects

One important shortcoming in Africa is the general deficiency in skills and capacity to propose or package transport projects for CDM. Africa has lagged behind the other regions with regard to GEF and AIJ projects for the same reason. Out of 101 AIJ projects conducted world wide, only one was in Africa and concerned forestry, not transport. Of all the GEF projects conducted in Phase I, less than 10 were in Africa and none were transport-related.

In particular, there is a lack of human resources for economic, financial and policy analysis. The conventional engineering wisdom does not track the best available transport technologies. Technology tracking is important in order to be able to choose the best technologies for CDM. Technological know-how will not be handed to African countries on a silver plate, as the developed countries know that they will be compromising their global competitiveness. Where business opportunities are available, the developed countries will be willing to install the technologies, for a return. Developed-country consultants will still be looking for opportunities to manage and maintain the systems in recipient countries.

Hence a deliberate policy on the part of African countries is necessary to demand participation of local technicians and managers in CDM projects so as to equip them to unpack, adapt, manage and maintain the in-coming technologies. This will lead to initiation of research and development (R & D) which is a prerequisite for the creation of local technologies in the future. Under the option presented in this paper, the capacity to design and maintain equipment and infrastructure and efficiently manage transport operations will be required at the regional level in order to ensure sustainability.

Conclusions and Recommendations

Conclusions

The transport sector in Africa is far from efficient in energy terms and with respect to service delivery. Improvements are required in the form of additional infrastructure, reliable mass transit systems, zero or low emission fuels and low energy intensity vehicles, all of which can increase access and mobility and reduce energy demand, GHG and local air emissions. In GHG emission terms, the transport sector is second only to the power sector. A number of

GHG mitigation options exist, but at a significant cost that African countries cannot afford. Other development priorities are more pressing than the GHG problem.

The continent is looking for possibilities to address some of its developmental requirements through technological and financial resource flows that may accrue from activities to reduce GHG emissions under the United Nations Framework Convention on Climate Change. The financial mechanisms include GEF, AIJ and the Clean Development Mechanism. Africa did not benefit much from GEF and the AIJ pilot phase, and no transport projects were financed by these sources. It is the CDM that holds promise for direct assistance to developing countries.

Framing possible CDM projects in the transport sector will be one way of simultaneously financing development and reducing GHG emissions. It is important to identify CDM transport projects where the GHG baseline and the potential emissions reduction can be evaluated to some reasonable degree of accuracy as this aspect will be critical in CDM certification. Examples of such projects are :-

- Substitution of bulk petroleum products by zero or low emission fuels or energy sources, which in the case of Africa could be hydropower and natural gas-based fuels (CNG and LNG).
- Corridor transport analysis where traffic movements are known and can be monitored. The corridor system improvements can then be related to potential reduction in energy demand and the associated GHG emissions reductions.
- Replacing road and rail freight petroleum delivery by a pipeline. The GHG emission reduction consequences of this can be evaluated to a reasonable degree of accuracy.

It will, however, be difficult to frame certain urban planning and transport management projects under CDM as such options cannot be directly correlated with GHG emission reductions. The whole transport sector analysis also suffers from non-uniform emission factors for the various modes and conditions of operation. There may be a need for an agreement on uniform emission factors to use in CDM transport projects.

To ensure that the developed country Parties invest in the transport sector, one potential CDM condition is that investors can only invest in their present area of operation. The sizes of CDM projects should be large enough to attract adequate funds for infrastructure building, and CDM finance should be for projects that the African countries themselves cannot finance from their national budgets.

For sustainability, CDM projects should include benefits such as the potential for technology leapfrogging in the recipient country, improved air quality, access and mobility, employment creation, economic efficiency and global market competitiveness. Adequate capacity and institutional and legal structures are required to efficiently design projects, manage various players and ensure future advances in technologies introduced in CDM projects.

Recommendations

1. If African countries are to benefit from CDM, it is imperative that working groups, steering committees or national CDM regimes be formed to assist in tracking the CDM debate and translating it into operational definitions leading to the design of projects, and to help scout for potential investors and package CDM projects.
2. Transport sector groups should work to improve activity data and emission factors for African operational conditions and transport modes.
3. Scenario building in the transport sector could also be initiated ahead of time for projects involving baseline construction and potential GHG emission reductions for selected options.
4. Portfolios of projects that are potential candidates for CDM could be compiled ahead of time.

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Cost-Effectiveness and Potential Benefits of Forestry Mitigation Projects under the Clean Development Mechanism

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Introduction

The Clean Development Mechanism was established by Article 12 of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). It is a project-based mechanism that aims to capture the divergent interests of developed and developing countries for the mutual realisation of global development and environmental management. CDM projects are to contribute to sustainable development in developing countries and to assist Annex I countries in *"achieving compliance with their quantified emission limitation and reduction commitments"*.

Initially, there were some concerns that forestry projects would not be eligible for CDM because it referred to projects with *"certified emission reductions"* (CERs). This implicitly excluded projects with sink enhancement potential. However, at the Fourth Session of the Conference of the Parties (COP-4) at Buenos Aires, Argentina, land use change and forestry projects were recognised as eligible.

The forestry sector is very strategic for Africa's active participation in climate change mitigation and adaptation. It is also the backbone of sustainable development in Africa. Forestry projects may therefore facilitate the realisation of CDM's sustainable development objectives. However, this may not be the case if socio-economic and development indicators are not considered in the strategic design and implementation of forestry projects[i]. For this reason, this study advocates the use of analytical frameworks that are sensitive to the sustainable development needs of African countries.

Using Ghana as a case study, and the Comprehensive Mitigation Analysis Process (COMAP) model as the analytical setting, this study presents some principles and indicators that are likely to be excluded in forestry policy formulation, cost-benefit analysis and prioritization of forestry projects in Africa. The evaluation considers the conformity of the projects with national forestry priorities, national development objectives, patterns of rural resource utilization

and equitable distribution of project costs and benefits. The cost-benefit assessment also uses principles that value rural production inputs like land and labour and direct benefits such as fuelwood and construction poles, which are often discounted in cost-benefit assessments.

The results of the Net Present Value of Benefit (NPV) analysis at a social discount rate of 3% indicate that CDM forestry projects could generate substantial financial benefits to rural communities in Ghana without the need for changing the scale or pattern of rural production activities. For example, the NPV of agroforestry projects that integrate both agricultural production activities and sustainable forest management practices is about $3200/ha. This illustrates the incentives available for broad-based implementation of agroforestry projects that are currently undertaken only as demonstration and research projects. Results of the Net Annualised Value of Benefit (NAVB) analysis indicate that a household in Ghana could receive about $300/ha/yr from either fuelwood plantation or through long fallow periods for natural regeneration of trees. This extra income could be used to purchase a gas stove or to help pay for household electricity use. In this way, CDM forestry projects could also accelerate diversified energy use and relieve the over-dependence of energy needs on the forest sector in Ghana.

Evaluation of Mitigation Options

There are several forestry mitigation projects that could be established in Ghana. Currently, there are various forestry projects that are established within the National Forestry Programs, or as bilateral agreements with donor organisations. There are also forestry projects established by multilateral agreements like the Biosphere reserves under UNESCO'S Man and Biosphere Programme and the World Heritage sites established under the World Heritage Convention[ii].

There is a condition of *"environmental additionality"* within the CDM provisions which may implicitly restrict the forestry projects that Ghana could establish to only those that are currently not stated in national forestry plans or under implementation. But if the interpretation of *"environmental additionality"* is extended to potential environmental benefits from improving forestry policy or monitoring then the enhancement of the environmental benefit from any forestry project could be considered as "additional". This interpretation will expand the ambit of CDM eligibility criteria to include the improvement of established national forestry projects in Ghana.

Apart from CDM eligibility criteria, this study also uses criteria such as the consistency of the projects with national forestry priorities, feasibility of implementation, equitable allocation of costs and benefits and the ecological impacts of the project[iii]. Other factors considered are the availability of land, carbon sequestration potential of the project, conformity with national development objectives, and community forest resource utilisation. The forestry mitigation projects considered in this study are 1. Forest protection, 2. Reforestation 3. Plantation, 4. Agroforestry, 5. Fuelwood plantation and 6. Reduced impact logging.

Baseline and Mitigation Scenarios

Use of the deforestation rate per annum can potentially conceal a lot of the elements responsible for deforestation, so the baseline estimates were based on the trend of future requirements for forest products and the corresponding area of forest land that would be needed to supply these products. The study produced statistical estimates of future wood requirements for timber, construction poles, fuelwood, and charcoal based on the current annual per capita production and consumption in cubic meters and the projected population growth rate. The equivalent land area in hectares required to supply this quantity of wood was estimated. The annual cropland area used for agricultural production was also estimated.

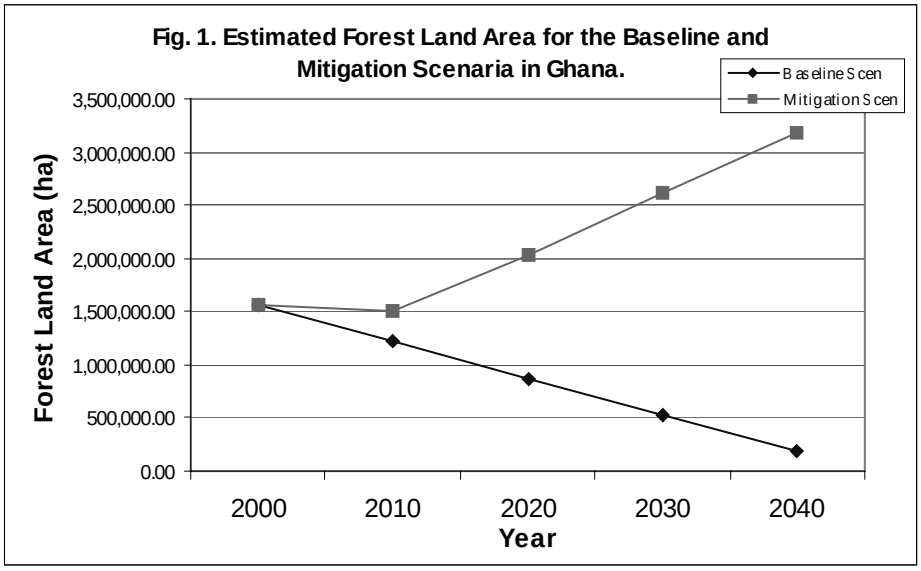

Figure 1. Estimated Forest Land Area for the Baseline and Mitigation Scenarios in Ghana.

Figure 1 compares the estimated forest area under the baseline and mitigation scenarios for a 40-year period. In the baseline scenario, about 80% of the forest in Ghana would be completely cleared or degraded at best. The forest sector plays a critical role as the second major source of foreign exchange (export of timber and agricultural products), and the major source of employment, raw materials, food, construction and energy in Ghana[iv]. Due to this high dependence on the forest sector, only about 20% of the original forest will remain in the year 2040, and 16% of this would be in reserves. Thus, only 4% of non-reserve forest would be available for fuelwood harvest or farming provided effective measures are established to prevent encroachment of reserves and culturally protected areas like burial grounds, shrines and sanctuaries. The effects of loss of forests on the economic security of Ghana must justify the benefits of sustainable forest management. The CDM must provide the opportunity for international co-operation and investment that will generate higher development outputs from the forests while managing them sustainability.

For the mitigation scenario, Figure 1 shows that although mitigation projects will generally increase the forest area, the gain could not offset the amount of forestland that would be de-

stroyed in the first rotation period. There is a 100% gain of forest area from mitigation projects at the end of the fourth rotation period. The study reveals a greater potential for forest regeneration in Ghana due to the large area of degraded and fragmented forests. The greater dependence on agricultural and timber production and the pattern of future development may require a broad-based national reforestation and agroforestry programme. Reduced impact logging and the control of illegal logging and trafficking should also be given priority.

Estimation of Carbon Sequestration Potential

To evaluate the carbon sequestration potential of the forestry projects, the study estimated biomss carbon density and soil density. The biomass densities used were based on Brown & Gaston (1995)[v]. Where data on biomass density is not available, it was determined by the formula suggested by Sathaye and Meyers (1995)[vi]:

Dry Biomass Density (t/ha) = SV*AS*TA*DW*WD , where
SV = Stemwood Volume (m^3/ha)
AS = Above-ground biomass over stem volume
TA = Total biomass to above-ground ratio
DW = Dry to wet biomass ratio
WD = Wood density (t/m^3).

Carbon density (tC/ha) was estimated by multiplying the biomass density (t/ha) by the carbon ratio (C%) which is the proportional carbon content of the trees. Soil carbon densities were estimated as percentages of the biomass densities depending on the degree of degradation of the forest before the project and the relative net primary productivity of the species considered for the projects. The total carbon density (tC/ha) was multiplied by the estimated potential area (ha) for each mitigation option to arrive at the total carbon storage potential[vii].

It has been noted that about 30-40% of carbon could be immobilised in wood products that oxidise at the end of their lifetime[viii]. However, the estimates do not include product carbon due to lack of data on the amount of carbon that could be stored in a product per hectare and the lifetime of products for the species considered in this study[ix].

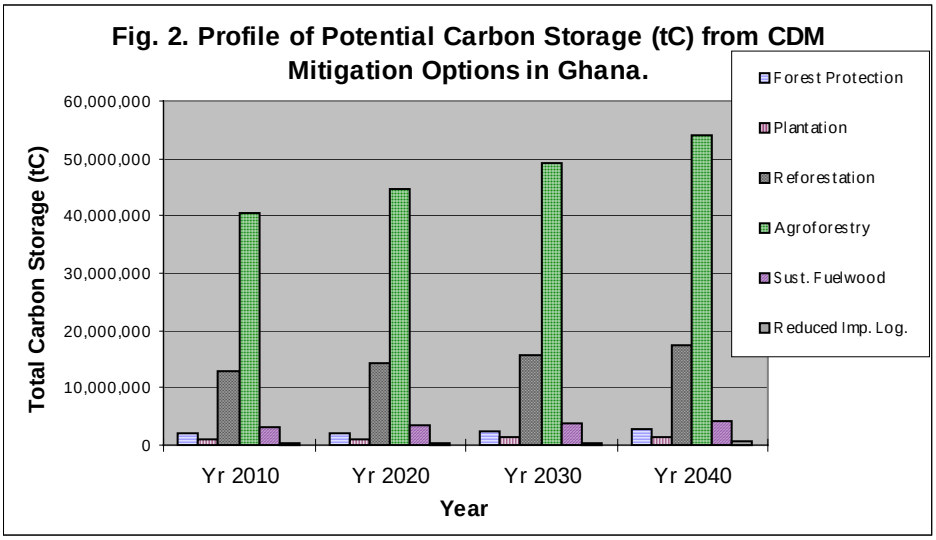

Figure 2. Profile of Potential Carbon Storage (tC) from CDM Mitigation Options in Ghana.

Figure 2 shows the potential carbon that could be sequestered by the different mitigation options. Potential carbon sequestration for the agroforestry mitigation option is higher. This does not mean that agroforestry projects have greater sequestration potential than the other forestry mitigation options, but rather is due to the extent of agricultural production in Ghana which has resulted in a relatively high annual percentage change in cropland of more than 5%[x]. The carbon that could be sequestered annually from a hectare of protected forest (6 tC/ha/yr) is about twice the potential for a plantation project (2.9 tC/ha/yr). The carbon sequestration potential of a natural forest could be greater than that of a plantation project even when carbon storage in wood products is included in the estimate[xi]. This provides an indication as to which sequestration projects should be given priority by national governments and Annex I agencies if projects are to serve other uses such as the preservation of biodiversity and the resource base for community development.

Cost-Effectiveness of Carbon Sequestration Options

To make CDM forestry projects attractive to rural communities, appropriate methodologies must be used to incorporate social, economic and ecological cost and deal with equity issues. This will also offer better guidance to policy-makers in prioritising CDM projects. The assessments should not only focus on the monetary costs and benefits, but also the beneficial impacts on global atmospheric carbon emissions, ecosystem restoration and preservation, socio-economic development and equitable distribution of benefits. The history of development has taught us a valuable lesson, that economic production approaches that relegate social and ecological concerns breed socio-economic inequality, and lead to marginalisation of the rural poor and environmental degradation. Policy makers must therefore consider all facets of a project prior to its implementation. This could be realised if the local communities are allowed greater participation in the design, planning and implementation of the forestry projects.

This study provides some guidelines for identifying the array of cost and benefit measurement principles that are sensitive to both the socio-economic needs of the rural communities and ecosystem integrity. This is intended to guide the implementation of forestry policies that seek to maximise socio-economic and ecological benefits and ensure equitable appropriation by local, national and international participants.

Cost assessment of mitigation options by the IPCC noted that the control of atmospheric carbon emissions by reforestation and sustainable forest management projects will cost about $8/tC/yr in the tropics and $28/tC/yr elsewhere[xii]. The IPPC estimate excluded the opportunity cost of land, and the cost of maintenance, monitoring and evaluation. Cost Estimates by Sedjo and Solomon (1988) noted that without the opportunity cost of land it will cost about $400 per hectare on average to implement forestry projects intended to sequester carbon[xiii]. Sathaye and Meyers (1995) have emphasised the importance of the opportunity cost of land in guiding the choice of policy and projects, given the array of alternative land uses in the forest zone. According to them, the opportunity cost will *"capture the benefits derived from land in the absence of the mitigation option"* (p. 11-11).

Some cost estimates of mitigation options consider the opportunity cost of land[xiv]. But the estimates were based on either the market price of land or the cost of land rental. The estimates excluded the lost productivity or income from the alternative production activities that the forest land could generate. Estimates of opportunity cost which include the cost of forest land, and the forgone benefits from alternative uses of forest are more sensitive to the needs of rural communities and will encourage the choice of projects which will bring supplementary benefits. The labour of farmers is often considered as *"necessary"* non-monetary input. This exclusion not only leads to under-estimation of the cost of production but it also implies that labour is not a factor of production in rural communities. The cost estimates in this study therefore include the establishment cost (land clearance, seedlings, labour), opportunity cost (cost of land rental and forgone benefits) and recurrent cost (seedling replacement, pruning, thinning, monitoring and maintenance).

The probability of failure of projects in Africa is relatively high. This is mostly due to a shortage of financial resources, managerial capacity and technical constraints and a lack of effective monitoring and re-evaluation of project costs and benefits. Some cost estimates are offered to guide the planning and budgetary evaluation of forestry projects throughout their implementation cycle.

The endowment cost is the sum of the establishment cost and the discounted value of all future investment and recurring cost during the lifetime of the project[xv]. This indicator is useful for forest protection projects that are not implemented on a rotational basis and as such do not generate benefits that could be used to finance the expenditure on future projects. It provides the endowment necessary to maintain the forestry project in perpetuity. Two social discount rates were used (3% and 10%) corresponding to the expected range of social discount rates used for development projects in developing countries[xvi].

The annualised value of cost, or the money that needs to be withdrawn from the endowment every year to finance the annual expenditures, was also estimated. This indicator is useful because it shows the amount of money that is needed to finance the recurring expenditures and signals the year or stage of the project when funding will not be available. In the case of rotation projects, if the annualised value of cost is higher than the annualised value of benefits,

then external sources of funding are needed if the project is not to be abandoned. With so many forestry projects abandoned or stalled due to lack of financial resources, this indicator will be useful as a guide for assessing a project's viability and financial sustainability.

Figure 3 shows the cost estimates for the mitigation options. The total cost of protecting a hectare of forest is about $8700/ha. Though the estimates may seem high[xvii], the variables and principles considered in the assessment make the estimated cost for forest protection more realistic. This is also due to the fact that forest protection projects may permanently remove the possibility of the area being used for alternative productive activities. In Ghana, where land is owned by clans, the government has to either forcefully take the land from communities or enter into entitlement arrangements with the land-owning clans. Forcefully taking land from the communities will create conflicting interests and increase the probability of project failure. The establishment cost therefore includes the cost of land (rent) assuming the land is to be purchased or rented from land-owning clans. It also includes the cost of seedlings, and labour.

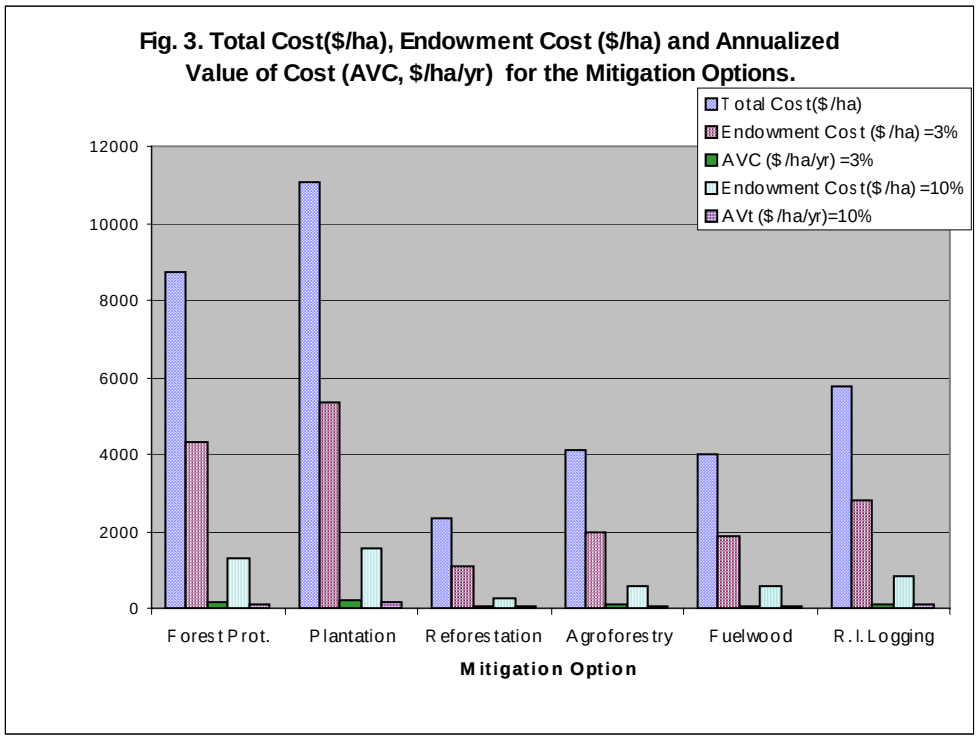

Figure 3. Total Cost ($/ha), Endowment Cost ($/ha) and Annualised Value of Cost ($/ha/yr) for the Mitigation Options.

The cost of maintenance and monitoring were considered as the recurrent expenditure. Using a 3% discount rate, the estimate indicated that about $4000/ha would need to be allocated for financing the reserve during its lifetime (in perpetuity). About $169/ha/yr would be needed to pay for the cost of conserving a hectare of forest every year. The estimates for the 10% discount rate are $1276/ha as the endowment cost and $129/ha/yr as the annualised value of cost. This indicates that using a high discount rate may result in an underestimate of the recurrent expenditure and a reduction in the amount of money necessary for conserving the project in

perpetuity. The high cost of forest protection and its low commercial benefits must prevent the sole use of market-based variables when estimating the costs and benefits of projects. As noted earlier, protected forest has high carbon sequestration potential and provides the opportunity for biodiversity conservation. These ecological values should not be discounted.

CDM reforestation projects should emphasise community participation, especially within the Taungya system. Effective community participation may demand agreements for equitable allocation of responsibilities, rights and benefits to the forestry products and sequestration proceeds. Within the system of enrichment planting, local communities could contract with the Forestry Department to plant and manage seedlings of commercially-viable species. They could also adopt long fallow periods for forest regeneration. Regeneration projects are relatively cheap[xviii], but the study internalised the cost of all these arrangements in the cost estimates. The study included the cost of the labour (man/hr/yr)[xix] that the community will devote to caring for the trees, monitoring and replanting and the opportunity cost of land. Treating the cost of community participation in forest management as externalities may result in market distortion, and decrease the incentives for community commitment to the success of forestry projects[xx].

The cost of regenerating a hectare of "degraded" forest is $2339/ha. About $1101/ha and $293/ha would be needed as endowment for natural regeneration projects at discount rates of 3% and 10% respectively. This is relatively lower than the estimated endowment costs for the other mitigation options. Less than $50/ha/yr would be used to finance annual recurrent cost for natural regeneration projects. This is affordable and viable.

Agroforestry and sustainable fuelwood utilisation projects integrate community-based productive activities with sustainable forest management practices. Increased population growth in Ghana is creating high population densities in arable areas with consequent effects on per-capita agricultural land and fuelwood consumption. Because most of the forest area has been cleared for farming and fuelwood supply is critical, agroforestry and fuelwood plantation projects need to be prioritised at all costs to ensure continued economic security. Agroforestry projects[xxi] may cost about $100/ha more than fuelwood plantations ($4008/ha). Endowment costs of between $500/ha to $2000/ha would be needed for Agroforestry and fuelwood projects. About $60/ha/yr would be needed to finance annual recurrent expenditure for the projects. It is uncertain if farmers could afford the costs of these projects but considering the low financial resources and the high risk-aversity of farmers, credit and insurance schemes must be established to enable them manage the projects successfully.

Plantation projects are the most costly to establish. The establishment cost included the cost of land clearance, equipment, labour, and the opportunity cost of lost income from agricultural and non-timber forestry products. The estimated total cost is $5778/ha. At a 3% discount rate, about $5300/ha would be needed to finance the recurrent cost necessary for completing the project. The endowment cost for reduced impact logging, however, would be about half that of plantation projects ($2813/ha). Natural forest still constitutes the major source of timber.

The higher ecological diversity of natural forest and its relatively low cost of implementation should make reduced impact logging projects preferable to mono-cropped plantation projects under the CDM. Spending between $80/ha to $100/ha annually should be affordable for the government and timber concession firms, considering the guaranteed sustainable source of timber and non-timber forest products. Some fiscal incentives and punitive policies (carrots

and sticks) should be used to sway concession firms from current destructive logging practices. The relationship between reduced impact logging and other international initiatives like certification of sustainable forest management is currently not clear. However, the possibility that reduced impact logging projects under the CDM could be used to secure certification of timber products should not be ruled out.

Analysis of Potential Benefits of CDM Forestry Projects

The carbon sequestration benefits would be additional to the traditional benefits obtainable from forest resources. Among the direct benefits that could be derived from mitigation projects are fuelwood, construction poles, and timber. Indirect services may include employment opportunities for local inhabitants, control of air pollution and micro-climate, watershed protection, and the development of social infrastructure such as schools, roads, and hospitals. There are other aesthetic and cultural benefits from forestry but this study has avoided the controversies that often shroud the estimation of indirect benefits and the allocation of monetary value to aesthetic and cultural benefits. Only direct benefits from fuelwood, timber, construction poles and other non-timber forest products are considered in the estimates[xxii].

For the reserved forests, it is anticipated that the current practice where local communities are given permits to collect dead and fallen branches as well as wood from the thinning process will continue[xxiii]. No benefits from non-timber products were estimated for plantation projects although some forest products like snails and mushrooms could be harvested from plantation projects.

Benefits from Carbon Sequestration

The financial benefits from carbon sequestration would be additional to the traditional benefits from forestry projects. It is currently very difficult to quote the specific monetary value that would be put on a ton of carbon sequestered. The negotiation history of the CDM and the value estimated by some Annex 1 countries like the United States based on the expected supply, demand and marginal cost of carbon sequestration could help in anticipating the price for a ton of carbon sequestered from a CDM project.

Brazil's proposal, which established the foundation for the CDM provision, suggested a *"compulsory contribution"*, or a financial penalty of about $10 for every tonne of carbon an Annex 1 Party emits in excess of the allocated ceiling. The proceeds from these *"compulsory contributions"* are to be used for funding carbon emission reduction projects in developing countries[xxiv]. However, even prior to the Brazilian CDM proposal, Costa Rica had been offering Certified Tradable Offsets (CTO) on the Chicago Stock Exchange at the price of $10 per ton of carbon. On the 24th of April, 1998, Costa Rica announced a CTO programme for the national reserve forest with a coverage of 5000 Km^2. It is anticipated that this program will provide about US$ 40/ha/year over a 15-year period[xxv].

A study by the United States' Council of Economic Advisors,[xxvi] which accounts for effective trading and developing country participation, estimated the price for an emission trading permit of between $14/ton and $23/ton of carbon. Among the issues considered in the US study was the benefit of reducing net emissions through carbon sink enhancement projects that might include forest conservation and reforestation. Based on the future supply and demand for CTOs from forestry projects and the competitive attraction of other project-based schemes for funding, this study anticipates that the price for a ton of carbon would be lower than the US estimates and would be closer to the figure proposed by Brazil ($10/tC).

Benefit Analysis

The study estimated the total benefits from CDM forestry projects. There is a time-specific value to the benefits obtainable from the forestry projects because of the differential monetary value at different rotation periods[xxvii]. The Net Present Value of Benefit (NPV) was estimated to enable comparison of the time-specific value of the benefits. The NPV is a discounted cash flow (DCF) technique that takes into account the current value of future benefits from CDM forestry projects to the participants. The social discount rates used were 3% and 10%. This corresponds with the range of discount rates used for evaluating projects in developing countries[xxviii].

The study also estimated the Net Annualised Value of Benefit which indicates the value of annual benefits obtainable from a hectare during the lifetime of the forestry project. A negative figure may imply that external source(s) of funding need to be secured for funding the projects, since annual expenditure exceeds annual benefits.

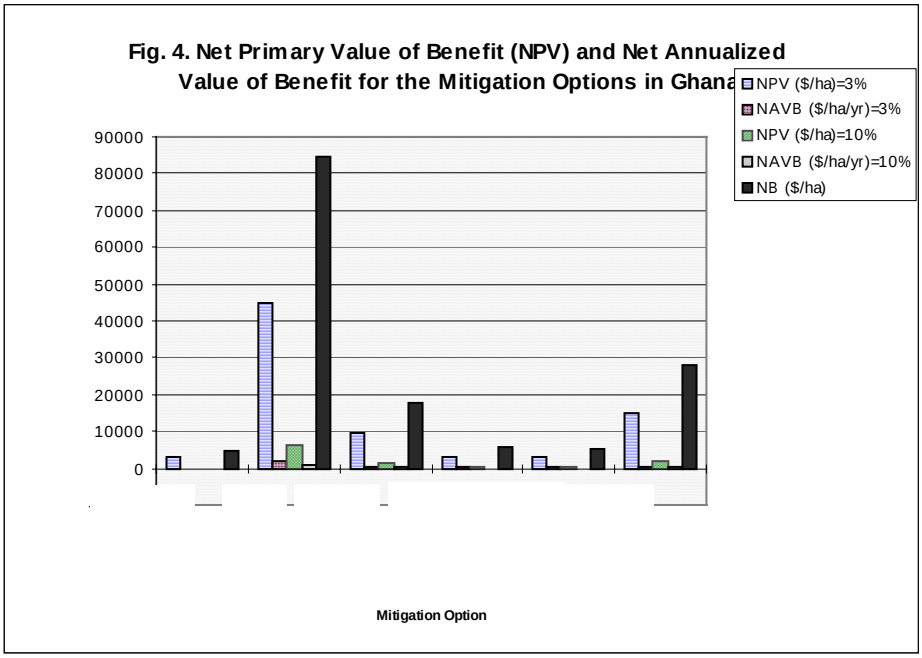

Figure 4. Net Benefit (NB), Net Present Value of Benefit (NPV) and Net Annualised Value of Benefit (NAVB) for the Mitigation Options in Ghana.

Figure 4 shows the estimated benefits from the mitigation options. The average net benefit from forestry protection projects[xxix] would be about $3400/ha. Half of this is benefits from carbon sequestration. However, the discount rate used for evaluating the costs and benefits of forest protection projects would determine their attractiveness. Since forest would be preserved in perpetuity with only thinning and occasional harvesting, a high discount rate could be used because of lack of immediate availability of preserved forests for farming or logging.

The NPV at a social discount rate of 10% was negative. The NPV at the 3% discount rate is, however, encouraging. But it must be noted that although the potential carbon sequestration from forest protection projects is about double that of other mitigation projects, the potential monetary benefit from forest protection is very disappointing. To make forest protection attractive, other arrangements must be made for technical, financial and managerial assistance that can reduce the cost of forest production and generate supplemental benefits to ones associated with traditional use and sequestration.

Plantation projects[xxx] and reduced impact logging projects[xxxi] have very high benefits. The NPV of plantation and reduced impact logging projects at a 3% discount rate are $44,750 and $14,792 respectively. Benefits from carbon sequestration are only 2% for plantation projects and 5% for reduced impacts logging projects. For reforestation projects[xxxii], because of the commercial benefits of species used for the enrichment planting, the Net Benefit is about $17,954/ha. The NPV at the 3% discount rate is $9567/ha ($1375/ha at the 10% discount rate). The annual net benefit from a hectare of reforested land may range from $100/ha/yr to $300/ha/yr.

If implemented under CDM, fuelwood lot and Agroforestry projects[xxxiii] have the potential to raise the income of rural communities. The net benefit from CDM Agroforestry and fuelwood plantation projects[xxxiv] may be about $4000/ha. This is more than farm income from fallow farming or shifting cultivation that involves clear-cutting, windrowing and burning of bush, which consequently emits substantial amounts of carbon into the atmosphere. Farm income from a bush-fallow farm with a 5-year rotation period is about $780/ha[xxxv]. Agroforestry projects also have the capacity to provide about 80% of household food demands[xxxvi]. On a per-unit delivered energy basis charcoal and fuelwood are the most expensive sources of energy. They are also the energy sources associated with the most critical environmental and health impacts. But because the cost of harvesting and the associated environmental impacts are externalised in their production cost assessments, they are sold at a relatively low price. They are also easily affordable due to the low capital investment needed to use charcoal or fuelwood. Under the CDM, sustainable fuelwood and charcoal utilisation projects could reverse the inefficient pricing of charcoal and fuelwood if the value of trees are priced not only based on their relative energy potential but also their carbon sequestration potential. By planting trees for fuelwood or leaving land fallow for tree regeneration a rural household in Ghana could earn an extra income of about $200/ha/yr. By choosing not to harvest the trees for fuelwood or charcoal, the household may use this extra income from CDM projects to purchase more efficient energy, such as liquefied petroleum gas (LPG). This is realistic because the benefits from carbon sequestration (assuming $10/tC) are much higher than the current price of LPG ($.00025/t)[xxxvii]. This will facilitate diversified and efficient energy use in Ghana.

Conclusion

One of the objectives of the CDM is to facilitate sustainable development in developing countries. However, this will not be realised if socio-economic and development indicators are not considered in project planning and implementation. This study has provided an analytical framework and principles that may be useful in recognising the socio-economic and development needs of rural communities. These communities constitute about 80% of the population in Africa and would be the active participants in CDM forestry mitigation projects.

The study has also provided some estimates that may be very useful for evaluating the feasibility of CDM projects, and for prioritising projects and ensuring their continued operation. For example, the estimated endowment cost will be useful in decisions and measures to maintain the viability and continuity of the forestry projects. The benefit assessments have also demonstrated the ecological and economic benefits of forestry mitigation projects. It is hoped that the framework and principles presented here may guide the cost-benefit assessment of forestry mitigation projects under the CDM.

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[ii] Consult Sayer, J. A., Harcourt, C. S., and Collins, N. M. (eds). 1992. *The Conservation Atlas of Tropical Forests:* Africa. The World Conservation Union (IUCN), London: Simon and Schuster.

[iii] Sathaye, J. and S. Meyers. 1995. "Greenhouse Gas Assessment: A Guidebook". *Environmental Science and Technology Library. Volume 6*. Kluwer Academic Publishers.

[iv] World Bank 1987. "Forestry Sector Review; Nketiah, K. S, & S. T. Addo. 1988. "The Charcoal Cycle in Ghana: Final Report of a baseline study; FAO 1987. "Ghana Forestry Project Preparation Report of the FAO/World Bank Co-operative Programme Investment Center. (58/87 CP-GHA 18; Sivilconsult. 1985. "The Forest Department Review. A useful concultancy report on Forestry Administration, stocking, growth rates, allowable cuts, timber concessions etc.

[v] Brown and Gaston. 1995. "Use of Forests Inventories and Geographic Information Systems to Estimate Biomass Density of Tropical Forests: Application to Tropical Africa". *Environmental Monitoring and Assessment 38: 157-168.*

[vi] Sathaye and Meyer 1995 (see note3)

[vii] For the options like plantation, reforestation, and farm forestry which may be harvested on a rotational basis and regenerated either by natural or planned plantation, the carbon stored per hectare was estimated by the formula:

$tC/ha = C_v \times T/2 + C_d \times t/2 + C_s \times T + \sum_i C_{pi} \times n_i/2$

where

C_v =average annual net carbon sequestered per hectare

T= rotation period

C_d = average annual carbon left to decompose per hectare

t = decomposition period

C_s = increase in soil carbon per hectare

C_{pi}= amount of carbon stored per hectare in product i and

n= life of product i

the divisions by 2 is based on the assumption that during the harvesting and replacement of the trees with similar species on the same plot, at least half of the carbon is sequestered indefinitely.

[viii] Dewar, R. & M. Cannell. 1992. "Carbon Sequestration in the trees, products and soils of forest plantations: An analysis using UK examples." *The Physiology, Vol. 11*. Pp. 49-71; Sathaye, J & S. Meyers. 1995 (see note 8).

[ix] The commercial logging species used due to available data on their productivity, standing and stem volume, density at harvestable age and logging diameter are teak, Cedrela, Aucomea, T. Ivorensis, T. superba, Tripochiton, G. arborea, and G. robusta.

[x] World Resources. 1998-99: A Guide to the Global Environment. WRI, UNDP and World Bank.

[xi] Brown, P., C. Bruce, and R. Livernash. 1997. "Carbon Counts: Estimating Climate Change Mitigation in Forestry Projects". World Resource Institute.

[xii] Intergovernmental Panel on Climate Change (IPCC). 1991/ "Climate Change: The IPCC Response Strategies". Island Press. Washington DC. IPCC. 1994. "Greenhouse Gas Inventory Reporting Instructions". IPCC Draft Guidelines for National Greenhouse Inventories. Vols. I & II. IPCC/OECD;

[xiii] Sedjo, R. and A. Solomon. 1988. "Climate and Forests". In Rosenberg, N. et al., (eds) *Greenhouse Warming: Abatement and Adaptation. 105-119,* Washington: Resources for the Future.

[xiv] Moulton, R. J. and K. R. Richards. 1990. "Costs of Sequestering Carbon through Tree Planting and Forest Management in the United States. USDA, Forest Service. General Technical Report WO-58. 48pp; Swisher, J. N. 1991. "Cost and Performance of CO2 Storage in Forestry Projects". *Biomass and Bioenergy. (6): 317-328.*

[xv] Swisher, J. N. and G. Masters. 1992. "A Mechanism to Reconcile Equity and Efficiency in Global Climate Protection: international carbon emission offsets". Ambio 21 (2): 154-159; Sathaye, J and S. Meyers. 1995 (*see note 8*)

[xvi] Markandya, A. and D. Pearce. 1988. "Environmental Considerations and the Choice of the Discount Rate in Developing Countries". The World Bank. Environment Department Working Paper No. 3; Sathaye, J., R. Norgaard, and W. Makundi. 1993. "A conceptual Framework for the Evaluation of Cost Effectiveness of Projects to Reduce GHG Emissions and Sequester Carbon". Lawrence Berkeley Laboratory Report, LBL-33859, Berkeley.

[xvii] The equivalent amount in US dollars of the cost of establishing, and maintaining a reserve quoted by forestry officers interviewed on the telephone ranges from about $ 1800 in Tanzania to $2250 per ha in Zimbabwe.

[xviii] most of these projects focus on the natural regeneration methods and the Tuagya system rather than the mechanized plantation system, the study used the average cost of natural regeneration given by FAO (1989) and Catinot (1986). The FAO figure is US$ 200-250/ ha. and Catinot's figure is US$125/ ha

[xix] A study by Kerkhof (1990) gave an average monthly income of $15 for a family managing 300 trees under the Turkana Rural Development Program (TRDP) in Kenya. Considering an average stem density of 100 stems per hectare which is normal for industrial trees like T. superba, A. klaineana, and N. diderichii this will be 3 hectares.

[xx] Ruitenbeck, H. J. 1990. "Economic Analysis of Tropical Forest Conservation Initiatives: examples from West Africa". World Bank Environment Paper No. 1. 241-272.

[xxi] The cost of land tillage and fencing for an agroforestry project in Senegal was about US$1100 (Kerkhof, 1990). The full cost (land clearance, planting, labor, maintenance) of micro-catchment and tree planting of the Forest Land Use Project (FLUP) in Guessebodi, Niger was $670 per hectare (Kerkhof, 1990). The average of these figures in addition to the opportunity cost of land was used for estimating the expenditure.

[xxii] The estimation of benefits from the sale of fuelwood and construction poles were based on data from Kerkhof, P. 1990. " Agroforestry in Africa: A Survey of Project Experience". PANOS Institute; Broder, J. M. & B. H. Odronic 1988. "Economic Potential of Agroforestry for Public Recreational Parks". *Agroforestry Systems, Vol. 10 pp. 99-112*.; Parren, M. P. E. and N. R. de Graaf 1995. "The Quest for Natural Forest Management in Ghana, Cote d'Ivoire and Liberia. *Tropendos Series 13.*

[xxiii] The estimation of the benefits from non-timber forest products were based on Falconer , J. 1990. " The Major Significance of 'minor' Forest Products: the local use and value in the West African humid forest zone. FAO Community Forestry Note 6. FAO, Rome, Italy, 232 pp. For food products from agroforestry projects, the estimation was based on Shah, P. 1984. " Economics of Wasteland Development Projects undertaken by Gujurat State Rural Development Corporation". Proceedings of a seminar on "Economics of wasteland development. New Delhi; Falconer, J. 1990. " Agroforestry and Household Security." In R. T. Pinley (ed) Agroforestry for sustainable production economic implications. London: Commonwealth Science Council. Estimation of the commercial value of timber was based on data from FAO Annual Report on Production and Consumption of Forest Products. 1993; 1995.

[xxiv] Cameron, J. and J. Werksman. 1998. "The Clean Development Mechanism: The 'Kyoto Surprise'". In Post Kyoto Strategies for International Cooperation and Private Sector Participation. Brazil/U. S. Aspen Global Forum Working Papers. June 18-21, 1998, Sao Paulo, Brazil.

[xxv] Allen, V. 1998. "Costa Rica to Save Forest with Carbon Credits" Reuters News Service, April 24, 1998. http://forests.org; Burnner, J. 1998. "Clean Development Mechanism of the Framework Convention on Climate Change: Issues and Opportunities for Central Africa. Draft presentation paper at the Central Africa Regional Program for the Environment. Bata, June 1998; Fearnside, P. Forests and Global Warming Mitigation in Brazil: Opportunities in the Brazilian Forest Sector for Responses to Global Warming under the Clean Development Mechanism and Joint Implementation Programs. Brazil/U. S. Aspen Global Forum. Sao Paulo, Brazil, June 18-21, 1998.

[xxvi] Council of Economic Advisers. 1998. The Kyoto Protocol and the Presidents Policies to address Climate Change: Administration's Economic Analysis. July 31, 1998.

[xxvii] Pandey, I. M. 1979. "Financial Management". Viskas Publishing House. New Delhi, India.

[xxviii] Markandya and Pearce. 1988 (*see note 41*).

[xxix] The reserve would not be logged but would continue to serve as a traditional source of fuelwood, and non-timber forest products like resin, gum, bushmeat etc which would be worth about 225/ha/yr (Falconer, 1992). The annual thinning process will provide wood for fuel, poles and charcoal which will be worth $170/ha/yr (Kerkhof, 1990). This will be in addition to the benefits from carbon sequestration. The benefits of carbon sequestration will start accruing in the year 2010 but the traditional benefits will take effect later than 2010. The capacity of a forest reserve to provide non-timber forest products will increase in the subsequent years because of the net annual incremental productivity being higher (no timber harvest just thining) than the net anual rate of utilization.

[xxx] FAO (1993) provides the total production and the harvestable volume (m^3/ha) for the species considered in this study. So the study determined the volume of timber that could be harvested from a hectare of land based on FAO's data. Since most of the timber produced from plantation are exported, it was assumed that half would be used domestically and half would be exported. The average unit price of the species at the international market (FAO 1995) divided by 2 (to reflect the local price since no data is available for domestic prices) was used for estimating the financial benefits from plantation projects. No consideration was given for non-timber forest products but the additional benefits from carbon sequestration assumed the value discussed above ($10/tC

[xxxi] The study anticipated that about 25% of the trees that replaced the original logged trees would also be logged for exports or domestic use at their harvestable or matured stage. Since reduced impact logging projects are noted to preserve about 80% of the ecological diversity of the original "unlogged" forest, it is assumed that it will also provide some non-timber

products to the communities or to the concessionnaires if the land concession included all the surrogate resources. The study therefore used the unit price per volume of roundwood at the international market used for estimating the benefits from the plantation projects, $132/ha from the sale of fuelwood sale and poles (Gaillard, 1988; Parren & de Graaf, 1995) and $225/ha/yr from non-timber products (Falconer, 1992).

[xxxii] The afforestation projects would be established mainly by the communities in cooperation with the National Forestry Departments. It is anticipated that, the resources from these projects would be domestically utilized for furniture, canoe, construction poles etc. The appropriate system to be adopted taking into consideration the involvement of the community is the natural regeneration option. This system would make available to the community non-timber forest products due to the diversity of the species that would be favored. A study done on the Yapo Project in Cote d Ivoire which involved natural regeneration of 10,000 ha of evergreen forest and financed by the European Community project between 1983-1988 indicated that about US$132/ha could be obtained from selling the trees in the domestic market. This figure was considered as relatively low in comparison with sawn timber and was probably due to the "give-away" prices common to concession contracts in Cote d Ivoire (Gaillard, 1988; Parren & de Graaf, 1995). The value per hectare of non-timber forest products based on Falconer (1992) and the carbon sequestration value per hectare was also used in estimating the benefits. It is also assumed that about 10% of the trees used in the enrichment planting would be sold for timber.

[xxxiii] Agroforestry could provide several direct benefits to the farming communities. Apart from the traditional food crops that could be harvested from the farms, the trees could provide fruits (especially from the fruit trees), serve as fuelwood, fodder, construction poles and other non-timber forest products. A study done on the Majjia Valley agroforestry project which was funded by CARE, USAID and DANIDA in Niger indicated that as much as US$1200 could be obtained from selling 900 poles from an agroforestry field of about 5 hectares with a 10-year rotation period for trees used as windbreaks. An additional US$170 was obtained from the sale of fuelwood to the local market (Kerkhof, 1990). Monetary value of the food crops, fruits, fodder and other forest products consumed by the farmers was not estimated. A study by Broder & Odronic (1988) based on linear programming showed that an agroforestry planting configuration of 1495 trees per ha with 75% hay, 25% grazing, and no minimal annual income requirement could generate about US$1780 per hectare. Assuming a modest monetary value of US$350 per hectare (Shah P, 1984) for the food crops, fruits and other products obtainable from agroforestry projects then an agroforestry farm with 10-year rotation period could generate about US$2200 per hectare. The financial benefits from carbon sequestration could be additional to the traditional income.

[xxxiv] Since the projects will be aimed at providing sustainable sources of wood for fuel and charcoal as well as for satisfying other non-timber forest products needs of the community, it is assumed that the benefits will approximate the proceeds from the sale of trees given by Broder & Odronic (1988) study in additional to the benefits from non-timber forest products quoted by Falconer (1992). The estimated benefits was therefore based on these figures.

[xxxv] Afful-Koomson, T. 1996. "Interactive Impacts of Fallow-Farming and Deforestation". Unpublished Mphil dissertation. Norwegian University of Science and Technology. Norway. June, 1996.

[xxxvi] Wiersum, K. F (ed). 1988. Viewpoints on Agroforestry. Second Edition. Wageningen, The Netherlands: Wageningen Agricultural University.

[xxxvii] The figure given was $.025/kg. This was converted to metric tons to make them comparable. 1,000 kilogram (kg) = 1 metric ton (t).Wereko-Brobby, C. 1993. "Innovative Energy Policy Instruments and Institutional Reform: The case of Ghana." In Karekezi, S and G. A. Mackenzie. "Energy Options for Africa: environmentally sustainable alternatives. ZED Books.

Acronyms and Abbreviations

AIJ	Activities Implemented Jointly
BOOT	Build Operate Own and Transfer
BOT	Build Operate and Transfer
CDM	Clean Development Mechanism
CER	Certified Emissions Reduction
CNG	Compressed Natural Gas
IBRD	International Bank for Reconstruction & Development
ECOWAS	Economic Community of West African States
ET	Emission Trading
FDI	Foreign Direct Investment
FROM	Finance Rehabilitate Operate and Maintain
GEF	Global Environmental Facility
GHG	Greenhouse gas
GWP	Global Warming Potential
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
LDV	Light Duty Vehicle
LNG	Liquid Natural Gas
MDB	Multilateral Development Bank
NGO	Non-governmental Organisation
ODA	Official Development Assistance
P-KM	Passenger- Kilometre
RDB	Regional Development Bank
R & D	Research and Development
SADC	Southern African Development Community
T-KM	tonne-kilometre
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change